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EFFECTS OF POROSITY ON WELD-JOINT TENSILE STRENGTH OF ALUMINUM ALLOYS

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lower and intermediate levels of porosity content. In highly concentrated levels of porosity, both yield strength and elongation values decrease markedly.

Correlation coefficients were obtained by simple straight line regression analysis between the variables of ultimate tensile strength and pore level. The coefficients were greater, indicating a better correlation, using a pore area accumulation concept or pore volume accumulation than the accumulation of the pore diameters. These relationships provide a useful tool for assessing the existing aerospace radiographic acceptance standards with respect to permissible porosity. In addition, these relationships, in combination with known design load requirements, will serve as an engineering guideline in determining when a weld repair is necessary based on accumulative pore level as detected by radiographic techniques.

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TABLE OF CONTENTS

	Page
SUMMARY	i
INTRODUCTION	2
EQUIPMENT AND TEST SPECIMEN PREPARATION	3
DISCUSSION AND RESULTS	8
CONCLUSIONS	28
APPENDIX	33
REFERENCES	. 56

LIST OF ILLUSTRATIONS

Figurë	Title	Page
1.	Panel geometry	6
2.	Flat weld position setup	7
3.	Transverse weld tensile specimen configuration for testing at ambient temperature	. 8
4.	Transverse weld tensile specimen configuration for testing at -320°F (-196°C)	. 9
5.	Graphic representation of spacing of simulated pores along the weld line of fusion	. 10
6.	Reproduction of typical radiographs	. 11
7.	Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T6 (0.107 in. = 0.272 cm sheet) versus percentage of accumulative area of porosity in cross-sectional plane	
8.	Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T651 (0.250 in. = 0.635 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane	
9.	Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T651 (0.50 in. = 1.27 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane	
10.	Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T6 (all three thicknesses) versus percentage of accumulative area of porosity in cross-sectional plane	
11.	Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.125 in. = 0.318 cm sheet) versus percentage of accumulative area of porosity in cross-sectional plane	
12.	Ultimate tensile strength of flush bead TIG weldments in allog 2219-T87 (0.250 in. = 0.635 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane	

LIST OF ILLUSTRATIONS (Concluded)

Figure	Title	Page
13.	Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.50 in. = 1.27 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane	23
14.	Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (all three thicknesses) versus percentage of accumulative area of porosity in cross-sectional plane	23
15.	Cryogenic (-320°F = 196°C) ultimate tensile strength of flush bead TIG weldments in alloy 2014-T651 (0.250 in. = 0.635 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane	25
16.	Cryogenic (-320° F = -196° C) ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.250 in. = 0.635 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane	26

LIST OF TABLES

Table	Title	Page
1.	Chemical Composition Limits of Base Metal and Filler Metal	4
2.	Porosity Measurements From Radiographs of Weld Samples	12
3.	Simple Straight Line Regression Analysis for Accumulative Pore Area Versus Ultimate Tensile Strength of Weldments in Alley 2219-T87	15
4.	Simple Straight Line Regression Analysis for Accumulative Pore Area Versus Ultimate Tensile Strength of Weldments in Alloy 2014-T6	, 16
5.	The Relationship Between Transverse Weldment Ultimate Tensile Strength and Pore Concentration for Alloy 2219-	. 30
6.	The Relationship Between Transverse Weldment Ultimate Tensile Strength and Pore Concentration for Alloy 2014-T6	. 31
A-1.	Flush Bead Pansile Results and Corresponding Porosity Measurement of TIG Weldments (4043 Filler Metal) in 0.107 Inch (0.272 cm) Sheet Aluminum Alloy 2014-T6	. 35
A-2.	Flush Bead Tensile Results for 0.250-In. (0.635-cm) Wide Specimens and Corresponding Porosity Measurements of TIG Weldments (4043 Filler Metal) in 0.250 in. (0.635 cm) Plate Aluminum Alloy	. 37
A-3.	Flush Bead Tensile Results for 0.50-In. (1.27-cm) Wide Specimens and Corresponding Porosity Measurements of TIG Weldments (4043 Filler Metal) in 0.250 In. (0.635 cm) Plate Aluminum Alloy 2014-T651	
A-4.	Flush Bead Tensile Results for 1.00-In. (2.54-cm) Wide Specimens and Corresponding Porosity Measurements of TIG Weldments (4043 Filler Metal) in 0.250 In. (0.635 cm) Aluminum Alloy 2014-T651	

LIST OF TABLES (Concluded)

Table	Title	Page
A-5.	Tensile Results and Corresponding Porosity Measure- ments of TIG Weldments (4043 Filler Metal) in 0.50 in. (1.27 cm) Plate Aluminum Alloy 2014-T651	41
A-6.	Flush Bead Tensile Results and Corresponding Porosity Measurements of TIG Weldments (2319 Filler Metal) in 0.125 In. (0.318 cm) Sheet Aluminum Alloy 2219-T87	45
A-7.	Flush Bead Tensile Results for 0.250-In. (0.635-cm) Wide Specimens and Corresponding Porosity Measurements of TIG Weldments (2319 Filler Metal) in 0.250 In. (0.635 cm) Aluminum Alloy 2219-T87	47
A-8.	Flush Bead Tensile Results for 0.50-In. (1.27-cm) Wide Specimens and Corresponding Porosity Measurements of TIG Weldments (2319 Filler Metal) in 0.250 In. (0.635 cm) Plate Aluminum Alloy 2219-T87	48
A-9.	Flush Bead Tensile Results for 1.00-In. (2.54-cm) Wide Specimens and Corresponding Porosity Measurements of TIG Weldments (2319 Filler Metal) in 0.250 in. (0.635 cm) Plate Aluminum Alloy 2219-T87	49
A-10.	Flush Bead Tensile Results and Corresponding. Porosity Measurements of TiG Weldments (2319 Filler Metal) in 0.50 In. (1.27 cm) Plate Aluminum Alloy 2219-T87	51
A-11.	Flush Bead Tensile Results for 0.50-In. (1.27-cm) Wide Specimens at -320°F (-196°C) and Corresponding Porosity Measurements of TIG Weldments (4043 Filler Metal) in 0.250 In. (0.635 cm) Plate Aluminum Alloy 2014-T651	54
A-12.	Flush Bead Tensile Results for 0.50-in. (1.27-cm) Wide Specimens at -320 F (-196 C) and Corresponding Porosity Measurements of TIG Weldments (2319 Filler Metal) in 0.250 in. (0.635 cm) Plate Aluminum Alloy 2219-T87	55

TECHNICAL MEMORANDUM X-64933

EFFECTS OF POROSITY ON WELD-JOINT TENSILE STRENGTH OF ALUMINUM ALLOYS

SUMMARY

Simulated porosity was introduced in weldments of aluminum alloys 2014-T6 and 2219-T87 (sheet and plate) by precision drilling. The simulated porosity was examined in terms of accumulative linear inch (cm) of pore diameters, accumulative volume, and accumulative area per unit length of weld, respectively. In addition, the summation of porosity area was expressed as percent pore area in a cross-sectional plane (cross-sectional area of tensile specimen). Each pore quantity was plotted against the corresponding ultimate tensile strength, yield strength, and elongation. The ultimate tensile strength of the weldments displayed the most significant correlation with the porosity concentration. The relationships between yield strength or elongation and porosity were either trivial or inconsequential in the lower and intermediate levels of porosity content. In highly concentrated levels of porosity, both yield strength and elongation values decreased markedly. Accumulative pore area and percent pore area in weldments of each base metal thickness displayed a very strong linear relationship with ultimate tensile strength. Simple straight line regression analysis showed correlation coefficients (r) which exceeded 0.900, and the square of the coefficients (r2) were in excess of the numerical value 0.810. In essence, this means that more than 81 percent of the total ultimate tensile strength variation can be explained by the associated accumulative pore area. In some cases, the correlation coefficient actually surpassed the value of 0.980.

The ultimate tensile strength of each individual value (all thicknesses) was plotted as a function of corresponding percent pore area for weldments of each alloy. These combined data exhibited a correlation coefficient of 0.882 for weldments of aluminum alloy 2014-T6, and a correlation coefficient of 0.913 for weldments of alloy 2219-T87.

Tensile tests conducted at -320°F (-196°C) with 1/4-in. (0.635-cm) thick plate weldments also showed strong linear relationships between simulated porosity level and ultimate tensile strength. The order of decreasing correlation coefficients was (1) area, (2) volume, and (3) linear concepts. Simple

straight line regression analysis yielded correlation coefficients in the range of -0.93 to -0.99 for the variables ultimate tensile strength versus either accumulative pore area or percent pore area.

The overall results of this evaluation show the most valid predictor of weld ultimate tensile strength to be the pore area concept. Percent pore area is another way of expressing pore area per unit length of weld. Accumulative volume per unit length of weld is also shown to be a strong indicator of joint strength. The correlation coefficient value between accumulative linear units per unit length of weld and tensile strength was relatively poor when compared to the coefficients obtained by using either pore area or pore volume versus ultimate tensile strength.

INTRODUCTION

The acceptance of weldments in aluminum alloys is governed by both surface quality and internal quality. Undercutting, cracks, suck-back, burnthrough, drop-through, lack of penetration, and misalignment are well known examples of objectionable surface defects. However, these problems can be recognized by visual or dye penetrant inspection. Undesirable internal defects are characterized by slag and dross inclusions, tungsten inclusions, lack of fusion, fissures, cracks, and porosity. Porosity is the major item observed in x-rays of welds. This investigation is concerned exclusively with spherical type macroporosity in an otherwise perfect weld in order that the effect of porosity alone upon joint weldment tensile properties can be examined. Porosity is generally caused by gaseous hydrogen believed in the high temperature arc during welding [2].

Weldments generally show varying amounts of internal porosity, as detected by radiographic techniques. Weldments are sometimes rejected because porosity is considered as excessive in accordance to radiographic acceptance standards. In the past, the standards have been based for the most part on conservative engineering judgements. The general trend has been to establish arbitrary radiographic acceptance standards with porosity slightly larger in diameter and slightly greater in quantity than normally encountered in controlled production welds; thus, variations do exist in porosity acceptance standards from one specification document to another. To maintain production schedules, sometimes larger pores than permitted by a standard have been tolerated and waived. It is the consensus that in some cases a repair may result in a weld of lower quality than the original porosity-laden weld, though the

appearance of the repaired weld might be superficially better on the radiographic film [3]. However, leaving an intact large pore or accepting an array of pores not conforming to a specified acceptance standard leaves some doubt as to the structural integrity of the joint. Perhaps, existing standards are excessively stringent, and if so, how much relaxation is possible? The primary objective of this investigation is to determine to what degree tensile properties relate to porosity content, as expressed in terms of accumulative linear, volume, and area measurements of porosity per unit length of weld.

Welding engineers and metallurgists have attempted to introduce porosity in welds by faulty welding procedures, such as contaminating either the abutting edges, the shielding gases, or a combination of both. However, correlating the level of porosity is ultimate tensile strength by these techniques remains rather questionable. First, the purity as well as the physical metallurgical characteristics of the weld metal is altered. Second, reproduction of pore geometries and pore sizes into additional weld panels falls short of expectations. Third and probably most important, the fracture path should pass through the porosity, and not through other extraneous defects, such as dross and oxides which are associated normally with impure weld metal [4].

This investigation used weldments of the highest quality, with precision drilled holes simulating porosity along the surface of the weld interface (line of fusion) of each tensile specimen. Pore diameters, depths, and geometries were carefully controlled and measured exactly. Defects on or near the weld surface are considered more harmful than defects within (internal) the weld deposit [5, 6]. The fracture path of 2219-T87 weldments passes through the fusion zone on a single line which best fits the weld fusion lines. The normal fracture path of 2014-T6 weldments passes through only one side of the weld, and this being at the line of fusion or approximately normal to the base metal surface. Therefore, the specimens utilized in this investigation represented the worst conditions possible because (1) simulated porosity appeared at the surface, and (2) the simulated porosity was positioned along the normal fracture path. Specimen data are tabulated in the Appendix.

EQUIPMENT AND TEST SPECIMEN PREPARATION

The base materials (sheet and plate), the filler wires, and the shielding gases were all procured to appropriate aerospace specifications. The chemical composition limits of each base metal and filler wire are shown in Table 1.

TABLE 1. CHEMICAL COMPOSITION LIMITS OF BASE METAL AND FILLER METAL (MAXIMUM UNLESS SHOWN AS A RANGE)

Element	2014	4043	2219	2319
Si	0.5-1.2	4.5-6.0	0.20	0.20
Fe	1.0	0.8	0.30	0.30
Cu	3.9-5.0	0.30	5, 8-6, 8	5, 8 -6. 8
Mn	0.4-1.2	0.03	0.20-0.40	0.20-0.40
Mg	0.2-0.8	0.05	0.02	0.02
Zn	0.25	0.10	0.10	0.10
Ti	0.15	0.20	0.02-0.10	0.10-0.20
v	_	-	0.05-0.15	0.05-0.15
Zr	_	-	0.10-0.25	0.10-0.25
Be	_	-	-	0.0008
Cr	0.10	_	_	-
Others Ea.		0.05*	0. 05	0.05
Others Totals	_	0, 15	0.15	0.15
Al	Remainder	Remainder	Remainder	Remainder

^{*}Beryllium 0.008 maximum in welding electrode and filler wire only.

Source of Data:

- Mayer, L.W. Alcoa Aluminum Alloy 2219; Alboa Green Letter, Revised January 1962
- 2. Aluminum 145, Al-17, Engineering Alloys Digest, Incorporated, June 1954
- 3. Welding Kaiser Aluminum, First Edition, 1967

Preweld sections (4 in. \times 24 in. = 10.6 cm \times 60.96 cm) used in this evaluation were fabricated from three thicknesses of 0.107-in. (0.272-cm) sheet, 0.250-in. (0.635-cm) plate, and 0.500-in. (1.27-cm) plate of 2014-T6, and also three thicknesses, 0.125 in. (0.318 cm), 0.250 in. (0.635 cm), and 0.500 in (1.27 cm) of 2219-T87. The short direction (4 in. = 10.16 cm) of each panel was cut parallel to the principal rolling direction. All the panels were cleaned as follows:

- 1. Soaked with alcohol and rinsed in water.
- 2. Soaked in hot (approximately 200° F/93°C) non-etchant type alkaline cleaner for 10 to 15 minutes and rinsed in water.
- 3. Immersed 1 to 3 minutes in a solution of 0.5 percent hydrofluoric acid and 5.0 percent nitric acid, by volume.
- 4. De-smutted by immersing in a 50 percent, by volume, so the a of nitric acid for 1 to 2 minutes, rinsed in water, and dried by thin a.

Final joint preparation consisted of draw filing the abutting edges, and scraping the two adjoining faces for a distance of approximately 3/4 in. (1.905 cm) away from the filed edge. These operations removed foreign matter embedded in the material surface, removed surface oxides, and removed gases absorbed in the material surface along the area to be welded. Figure 1 shows the metal surface removal locations and the configuration of a section.

The weldments we a made by the TIG process on standard welding equipment, which consisted of an Airco Function Controlled welding power supply, Model FCWS-3049 and Model HMW-E voltage controlled welding head. Work pieces were held consistently by clamping fixtures, and travel speeds were provided by an automatic rack drive system. Square butt-joint weldments were made in the down hand (flat) position as shown by the welding setup in Figure 2. One weld pass was used to complete weldments in thicknesses up to 0.250 in. (0.635 cm). Two passes (one from each side) were required to weld 1/2-in. (1.27-cm) thick plate. Filler alloys were types 4043 and 2319 in combination with base alloys 2014 and 2219, respectively. Radiographic inspection followed procedures which usually grade weldments to Class I, per MSFC-SPEC-259A [7].

The weld bead reinforcements were machined flush and smooth (16 RMS) with the base metal surface. Tensile specimen configuration consisted of simple strips with parallel edges (Fig. 3) for ambient temperature testing, and a ''dog bone' pin hole type specimen (Fig. 4) for testing at -320°F (-196°C).

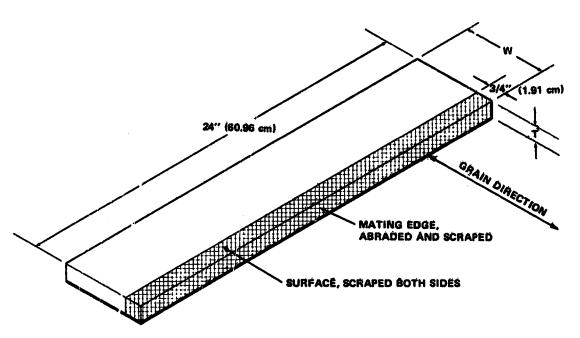


Figure 1. Panel geometry.

A precision drilling machine was used to drill simulated porosity in test specimens. The machine was equipped with a X-Y coordinate table for precise positioning of the specimen and exact spacing of holes, a vise for holding and leveling the specimen, and a dial indicator for controlling the depth of each hole. Standard high speed precision twist drills were used to make all holes.

Drilling, spacing, and measuring procedures were as follows:

- 1. Hole diameters and depths were varied in twenty steps from 0.009 in. (0.023 cm) to 0.203 in. (0.516 cm); however, in no case did the hole diameter or depth exceed three-quarters of the base metal thickness.
- 2. The depth of each hole was controlled to equal the diameter of the drill. This was done to approach, as near as possible, simulated spherical-type porosity.
- 3. Single hole specimens consisted of one hole drilled at the weld fusion line, but mostly within resolidified metal, at a position which bisected the width of the tensile specimen.
- 4. Multiple hole specimens consisted of identical holes drilled in a straight line at two diameter intervals, along the weld fusion line as stated in paragraph 3. Each array of holes, from two up to fifty individual pores, was centered with regard to specimen width. A graphic representation is shown in Figure 5.



OF POOR QUALITY

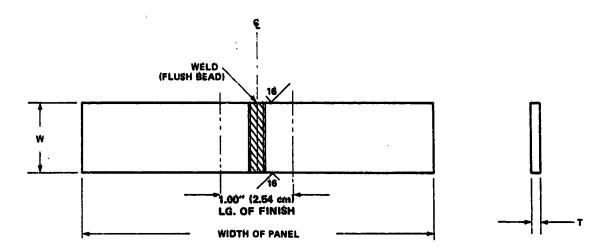


Figure 3. Transverse weld tensile specimen configuration for testing at ambient temperature.

- 5. The max num number of holes drilled in any given specimen was dictated by hole diameter, base metal thickness, and the spacing procedure as stated in procedure 4.
- 6. Drills were changed at selected intervals during the drilling operation. This was done to maintain a sharp and clean drill, which assured a consistent hole diameter throughout the drilling operation.
- 7. A typical hole for each drill diameter was made in 1/4-in. (0.635-cm) wide by 1/4-in. (0.635-cm) thick plate weldment at selected intervals during the drilling operation. Each specimen was radiographed, and the resultant film was used to exactly measure hole dimensions with the aid of a Mikon Tool Microscope. These dimensions were converted into pore area, pore volume, or linear inch (cm) of porosity. Reproductions of typical radiographs are shown in Figure 6. The dimensions, as measured from the radiographs, are shown in Table 2.

DISCUSSION AND RESULTS

In this evaluation, a technique was employed which introduced porosity (simulated) and still maintained normal metal quality along the deposited weld seam, or stated more specifically, the weld metal was not altered with regard to either purity or normal physical metallurgical characteristics. Weldments

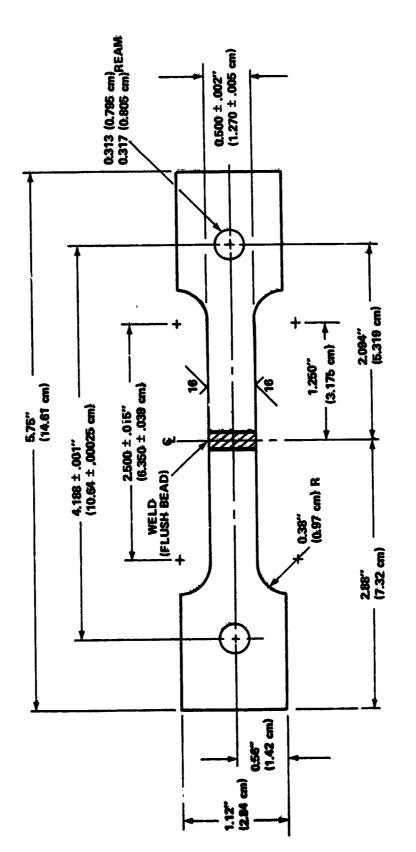
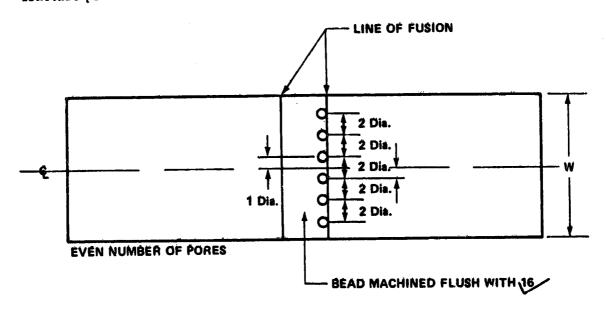


Figure 4. Transverse weld tensile specimen configuration for testing at -320° (-196°C).

were carefully selected with regard to initial quality and only weldments void of internal discontinuities, as disclosed by radiographic techniques, were used in this evaluation. The location of the simulated porosity was carefully positioned along the weld interface (line of fusion) which is included within the expected fracture plane.



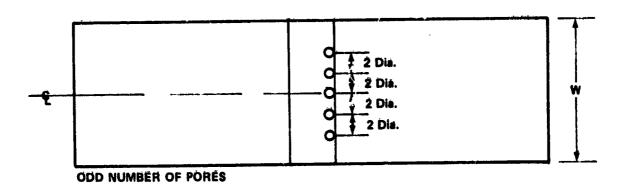


Figure 5. Graphic representation of spacing of simulated pores along the weld line of fusion.

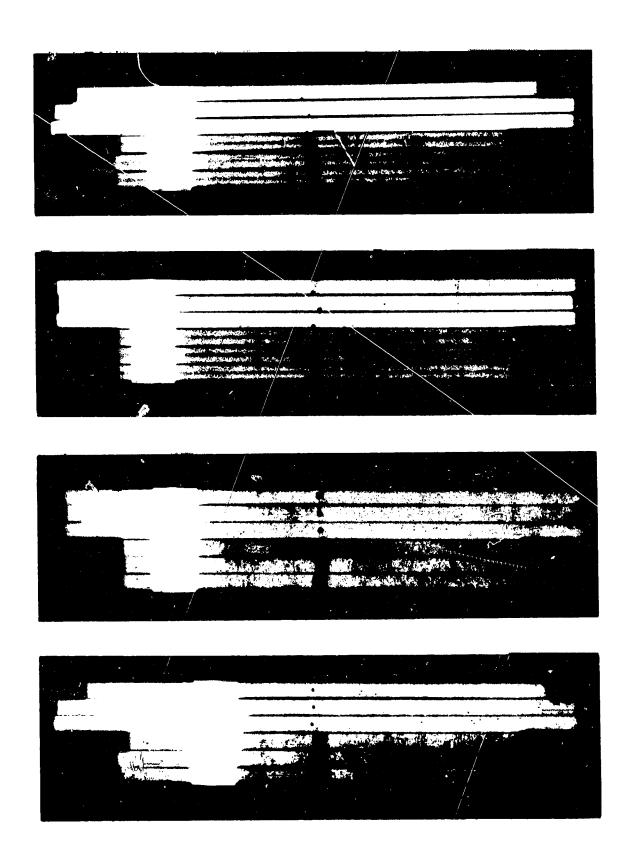
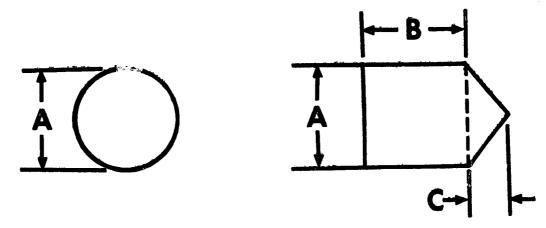


Figure 6. Reproduction of typical radiographs.

■ TABLE 2. POROSITY MEASUREMENTS FROM RADIOGRAPHS OF WELD SAMPLES



PORE MEASUREMENT, INCH (CM)				
Drill Diameter Inch (cm)	A	В	C	
0.0135 (0.0343) 0.0135 (0.0343)	0.012 (0.030) 0.C12 (0.030)	0.010 (0.025) 0.005 (0.013)	0.003 (0.007) 0.001 (0.003)	
0.0135 (0.0343)	0.012 (0.030)	0.005 (0.013)	0.001 (0.003)	
0.020 (0.051)	0.018 (0.046)	0.015 (0.038)	0.005 (0.013)	
0.020 (0.051)	0.016 (0.041)	0.013 (0.033)	0.004 (0.010) 0.005 (0.013)	
0.020 (0.051)	0.017 (0.043)	0.017 (0.043)	0.003 (0.013)	
0.031 (0.079)	0.029 (0.074)	0.021 (0.053) 0.029 (0.074)	0.0105 (0.027)	
0.040 (0.079)	0.039 (0.099)	0.029 (0.074) 0.032 (0.081)	0.0103 (0.027)	
0.040 (0.079)	0.038 (0.097)	0.032 (0.031)	0.007 (0.018)	
0.040 (0.079)	0.037 (0.094) 0.0505 (0.128)	0.037 (0.094)	0.012 (0.030)	
0.052 (0.132) 0.0595 (0.151)	0.0503 (0.128)	0.0435 (0.110)	0.016 (0.041)	
0.0595 (0.151)	0.062 (0.157)	0.041 (0.104)	0.015 (0.038)	
0.0595 (0.157)	0.061 (0.155)	0.041 (0.104)	0.015 (0.038)	
0.070 (0.178)	0.071 (0.180)	0.054 (0.137)	0.015 (0.038)	
0.081 (0.206)	0.082 (0.208)	0.060 (0.152)	0.019 (0.048)	
0.081 (0.206)	0.077 (0.196)	0.054 (0.137)	0.022 (0.056)	
0.081 (0.206)	0.077 (0.196)	0.056 (0.142)	0.026 (0.066)	
0.089 (0.226)	0.0875 (0.222)	0.067 (0.170)	0.021 (0.053)	
0.0995 (0.253)	0.099 (0.251)	0.076 (0.193)	0.023 (0.058)	
0.0995 (0.253)	0.103 (0.262)	0.070 (0.178)	0.028 (0.071) 0.026 (0.066)	
0.0995 (0.253)	0.100 (0.254)	0.075 (0.191)	0.026 (0.066)	
0.110 (0.279)	0.111 (0.282)	0.081 (0.206) 0.088 (0.224)	0.026 (0.081)	
0.120 (0.305)	0.121 (0.307) 0.120 (0.305)	0.083 (0.211)	0.037 (0.094)	
0.120 (0.305) 0.120 (0.305)	0.120 (0.305)	0.081 (0.206)	0.035 (0.089)	
0.1285 (0.32%)	0.132 (0.335)	0.094 (0.239)	0.038 (0.097)	
0.1405 (0.357)	0.145 (0.368)	0.100 (0.254)	0.038 (0.097)	
0.1405 (0.337)	0.147 (0.373)	0.100 (0.254)	0.044 (0.112)	
0.1405 (0.357)	0.146 (0.371)	0.099 (0.251)	0.041 (0.164)	
0.1495 (0.380)	0.150 (0.381)	0.100 (0.254)	0.047 (0.119)	
0.161 (0.409)	0.1625 (0.413)	0.116 (0.295)	0.0425 (0.108)	
0.1695 (0.411)	0.174 (0.442)	0.127 (0.323)	0.041 (0.104)	
0.180 (0.457)	0.185 (0.470)	0.142 (0.361)	0.042 (0.107)	
0.191 (0.485)	0.193 (0.490)	0.1365 (0.347)	0.052 (6.132)	
0.2031 (0.516)	0.208 (0.528)	0.143 (0.363)	0.054 (0.137)	

NOTE: Each value shown is the average of three or more measurements.

The higher porosity (simulated) concentrations and larger diameters used in this effort greatly exceed those limitations imposed by existing aerospace specifications. Simulated porosity diameters ranged from 0.009 in. (0.023 cm) to 0.203 in. (0.516 cm). The accumulative porosity area, volume, and linear summation of pore diameters varied from 0 to 0.0717 in. (0.463 cm²), 0 to 0.0078 in. (0.0503 cm³), and 0 to 0.582 linear inch (1.478 cm), respectively, per linear inch (2.54 cm) of weld. The percent of pore area present in a unit length of weld varied from 0 to 36 percent. Pore diameter was measured by adding the long and short diameters and dividing by two. However, the two diameters (long and short) were approximately equal in most cases, and in only two cases did the two lengths vary by more than 0.006 in. (0.015 cm). The percent pore area was calculated by dividing the accumulative pore area by the cross-sectional area of the test specimen and multiplying by 100.

To determine quantitatively how much the pore concentration variable affects the mechanical properties of a weldment, a linear regression analysis statistical technique was applied. A simple, straight-line regression analysis was made when a linear trend was apparent after plotting accumulated data in scatter diagram. The ultimate tensile strength plots of the welds displayed the most significant correlation with simulated porosity level. Changes in yield strength and elongation values were either trivial or inconsequential in the lower and intermediate levels of porosity. In highly concentrated porosity-laden specimens, both yield strength and elongation values decreased markedly, as shown by the data obtained. The data used for this analysis are shown in the Appendix.

Simple, straight-line regression analysis fits a straight line to a series of points, as plotted by two variables. The correlation coefficient (r) is a measure of the linear relationship between two variables, and must be between +1.00 and -1.00. A correlation coefficient of +1.00 indicates a perfect direct linear relationship, while -1.00 would indicate a perfect inverse linear relationship. A correlation coefficient of zero indicates a complete absence of linear relationship. The square of the correlation coefficient (r^2) gives the percentage of total variation explained (fitted) or removed by the regression line [8].

If the linear relationship between two variables is assumed, the equation of the correlation coefficient is:

$$\mathbf{r} = \frac{N(\Sigma XY) - (\Sigma X) (\Sigma Y)}{\sqrt{[N(\Sigma X^2) - (\Sigma X)^2][N(\Sigma Y^2) - (\Sigma Y)^2]}}$$

The equation of the least square line, or straight regression line of Y on X is:

$$Y' = a + bX$$

The slope b of the regression line is:

$$b = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{N(\Sigma X^2) - (\Sigma X)^2}$$

The Y-intercept (a) of the regression line [9] is:

$$a = \frac{\sum Y - b(\sum X)}{N}$$

Sample calculations of accumulative pore area versus ultimate tensile strength for each of three base weldment thicknesses are shown in Tables 3 and 4.

The porosity level was plotted against the corresponding tensile properties for each alloy, which included each thickness as a separate plot. Porosity level was expressed in terms of accumulative pore area, accumulative pore volume, and the accumulative linear pore diameter per unit length of weld, respectively, as well as percent pore area. Simple straight line regression analysis was performed because of the strong evidence of linear trends between ultimate tensile strength and the corresponding porosity level. The plots of the ultimate tensile strength versus percentage pore area for each thickness are presented in Figures 7 through 16.

All of the data plotted originated from measurements of 1,890 individual specimens tested at Marshall Space Flight Center (MSFC). The 2014-T6 specimens, welded with 4043, ranged in thickness from 0.107 in. (0.272 cm) to 0.500 in. (1.27 cm) and in width from 0.25 in. (0.635 cm) to 1.00 in. (2.54 cm). The number of individual pores drilled per specimen ranged from 0 to 50. The 2219-T87 specimens, welded with 2319, ranged in thickness from 0.125 in. (0 (0.318 cm) to 0.500 in (1.27 cm) and in width from 0.250 in. (0.635 cm) to 1.00 in. (2.54 cm). The number of individual pores drilled per specimen ranged from 0 to 40. Tests were made at room temperature in air and at -320°F (-196°C) in liquid nitrogen.

TABLE 3. SIMPLE STRAIGHT LINE REGRESSION ANALYSIS FOR ACCUMULATIVE PORE AREA VERSUS ULTIMATE TENSILE STRENGTH OF WELDMENTS IN ALLOY 2219-T87

Equation of the correlation coefficient (r):

$$\mathbf{r} = \frac{N(\Sigma X Y) - (\Sigma X) (\Sigma Y)}{\sqrt{[N(\Sigma X^2) - (\Sigma X)^2][N(\Sigma Y^2) - (\Sigma Y)^2]}}$$

Slope (b) of regression line:

$$b = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{N(\Sigma X^2) - (\Sigma X)^2}$$

The Y- intercept (a) of the regression line:

$$a = \frac{\sum Y - b(\sum X)}{N}$$

Equation of least square line (Y or X):

$$Y' = a + bX$$

Let Y = Transverse U.T.S. of weldment (flush bead) X = Accumulative pore area

	Base Sheet Thickness of 0.125 Inch (0.318cm)	Base Plate Thick- ness of 0.250 Inch (0.635cm)	Base Plate Thickness of 0.50 Inch (1.27cm)
N	52	53	96
ΣΧ ΣΥ ΣΥ ² ΣΥ ² ΣΧΥ	0.53983	0.7731795	2. 19799
ΣY_2	1,811,230	2,047,560	3,834,980
ΣX_{2}^{ω}	0.0094259561	0.0231671242	0.0934600823
ΣY^2	63,547,332,500	79, 549, 312, 000	153, 526, 256, 600
ΣXY	17,522.1165	27, 634. 26384	84,411.6523
r	-0.966	-0.972	-0.903
b	-335, 153. 8	-188, 104	-78,659.3
а	38,310.7	41,377	41,748.7
Υ¹	38, 310. 7-335, 153. 8X	41,377-188,104X	41,748.7-78,659.3X

NOTES:

- 1. These calculations were made from data obtained with 1-inch (2.54-cm) wide tensile specimens.
- 2. Individual Y and X values used in these calculations were the average value taken from 3 or more duplicate tests.

TABLE 4. SIMPLE STRAIGHT LINE REGRESSION ANALYSIS FOR ACCUMULATIVE PORE AREA VERSUS ULTIMATE TENSILE STRENGTH OF WELDMENTS IN ALLOY 2014-T6

Equation of the correlation coefficient (r):

$$\mathbf{r} = \frac{\mathbf{N}(\Sigma \mathbf{X} \mathbf{Y}) - (\Sigma \mathbf{X}) (\Sigma \mathbf{Y})}{\sqrt{[\mathbf{N}(\Sigma \mathbf{X}^2) - (\Sigma \mathbf{X})^2][\mathbf{N}(\Sigma \mathbf{Y}^2) - (\Sigma \mathbf{Y})^2]}}$$

Slope (b) of regression line:

$$b = \frac{N (\Sigma XY) - (\Sigma X)(\Sigma Y)}{N (\Sigma X^2) - (\Sigma X)^2}$$

The Y intercept (a) of the regression line:

$$a=\frac{\Sigma Y-b \ (\Sigma X)}{N}$$

Equation of least square line (Y on X):

$$Y' = a + bX$$

Let Y = Transverse U.T.S. of weldment (flush bead)

X = Accumulative pore area

		SUMMATION	
	2014-T6 Sheet Thickness of 0.107 inch (0.272 cm)	2014-T651 Plate Thickness of 0.250 inch (0.635 cm)	2014-T651 Plate Thickness of 0.50 inch (1.27 cm)
N EX EY ₂ EX ² EXY ² EXY r b a Y'	54 0.54088 2,111,090 0.0094265914 83,622,797,500 19,173.3787 -0.943 -491,877 44,021 44,021	53 0.771717 2,339,860 0.02358159059 103,951,043,000 31,378.1361 -0.950 -218,055 47,323 47,323-218,055X	142 5.19185 6,268,460 0.3730997403 278,095,342,000 215,102.9397 -0.886 -76,860.61 46,954 46,954-76,860.61X

NOTES: 1. These calculations were made from data obtained with 1-inch (2.54-cm) wide tensile specimens.

^{2.} Individual Y and X values used in these calculations were the average value taken from 3 or more duplicate tests.

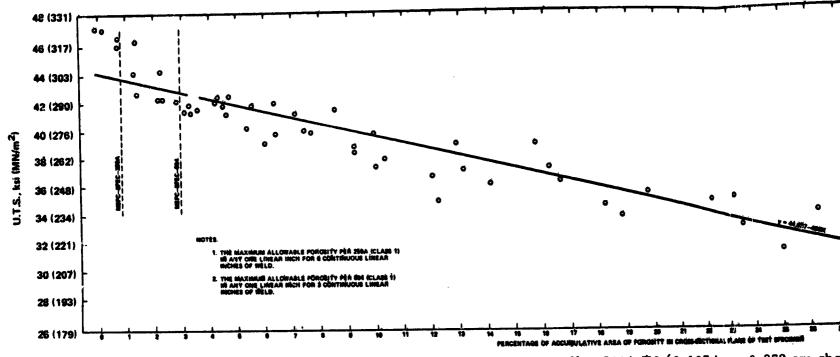


Figure 7. Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T6 (0.107 in. = 0.272 cm she versus percentage of accumulative area of porosity in cross-sectional plane.

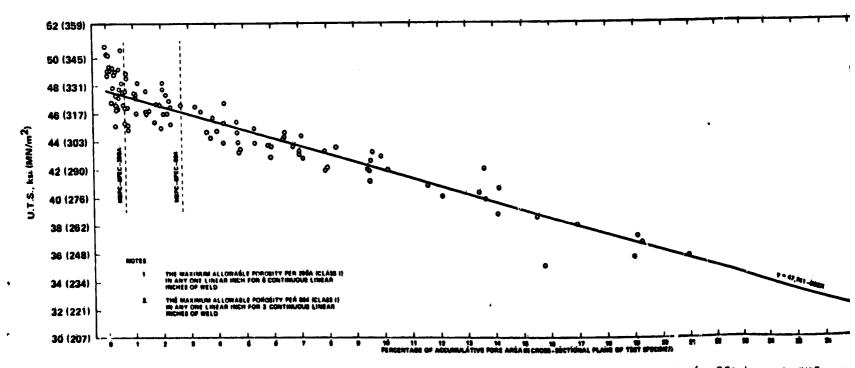
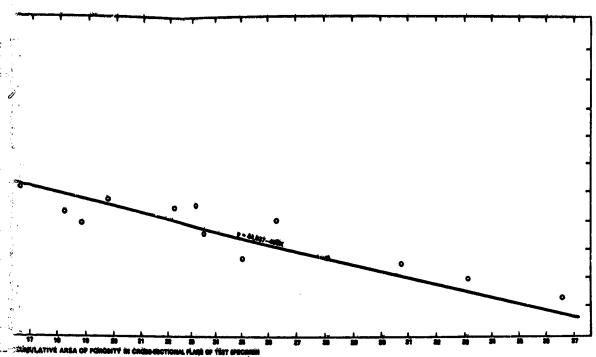
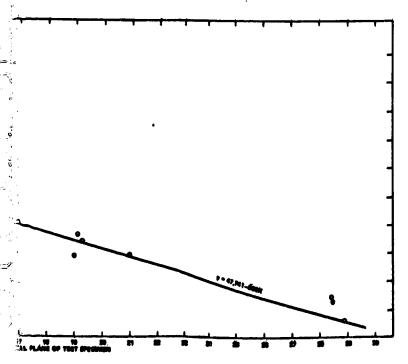


Figure 8. Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T651 (0.250 in. = 0.635 cm versus percentage of accumulative area of porosity in cross-sectional plane.

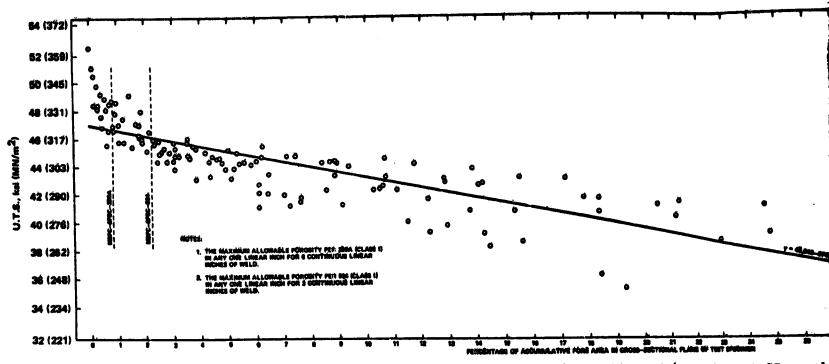


alloy 2014-T6 (0.107 in. = 0.272 cm sheet) in cross-sectional plane.



illoy 2014-T651 (0.250 in. = 0.635 cm plate) in cross-sectional plane.

FOLDOUT FRAME



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Figure 9. Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T651 (0.50 in. = 1.27 cm plane versus percentage of accumulative area of porosity in cross-sectional plane.

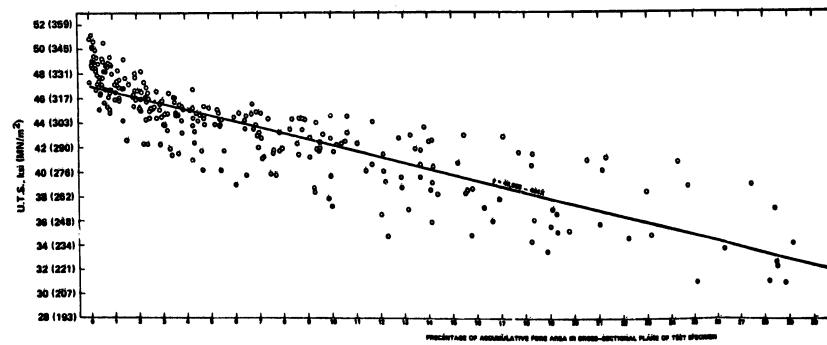
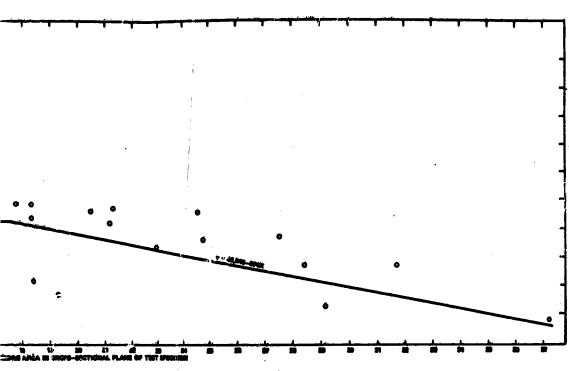
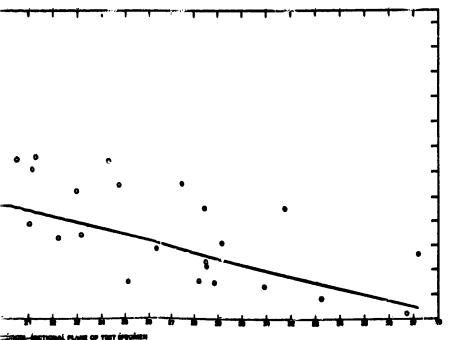


Figure 10. Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T6 (all three thicknesses) percentage of accumulative area of porosity in cross-sectional plane.



⇒y 2014-T651 (0.50 in. ≈ 1.27 cm plate) cross-sectional plane.



oy 2014-T6 (all three thicknesses) versus ross-sectional plane.

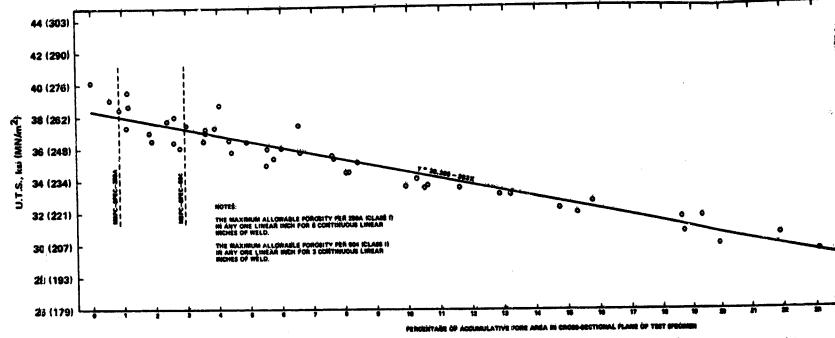


Figure 11. Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.125 in. = 0.318 cm s versus percentage of accumulative area of porosity in cross-sectional plane.

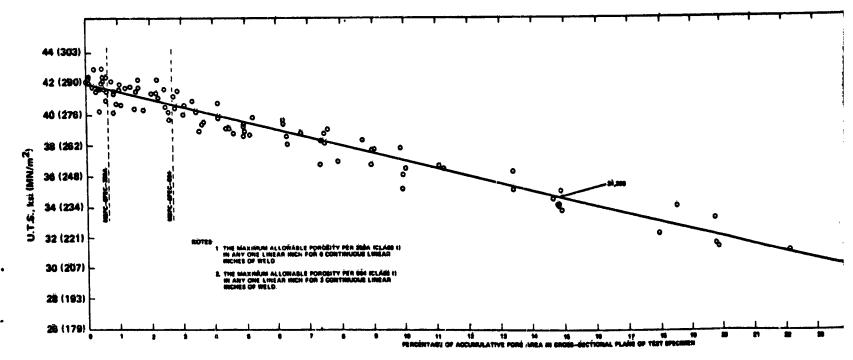
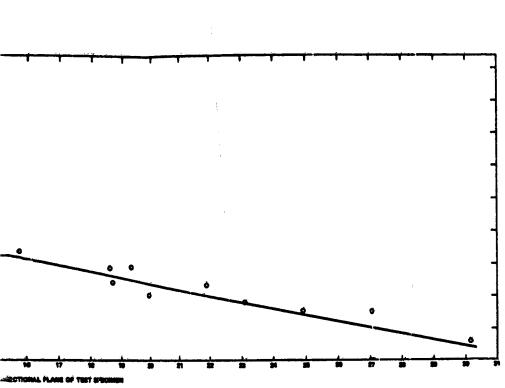
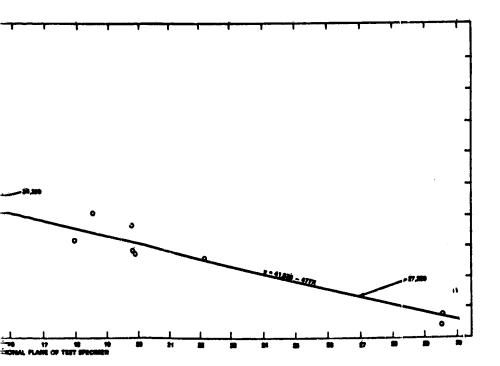


Figure 12. Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.250 in. = 0.635 cm versus percentage of accumulative area of porosity in cross-sectional plane.



Dy 2219-T87 (0.125 in. = 0.318 cm sheet) in cross-sectional plane.



⊃y 2219-T87 (0.250 in. = 0.635 cm plate) _n cross-sectional plane.

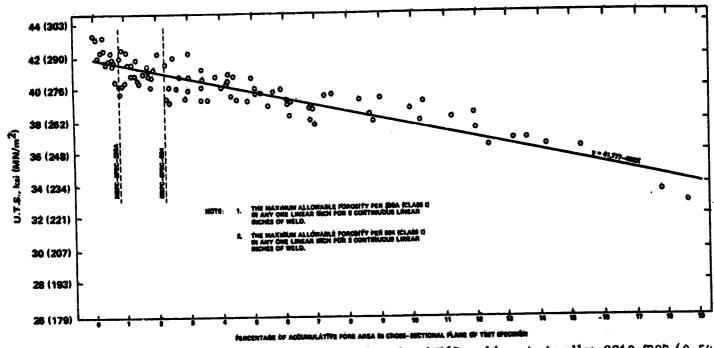


Figure 13. Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.50 in. = 1.27 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane.

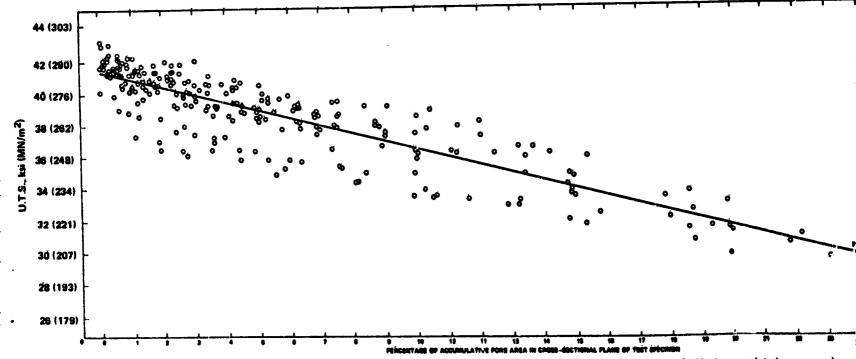
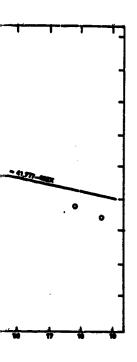
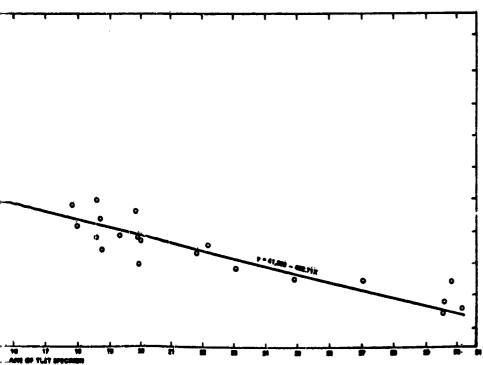


Figure 14. Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (all three thicknesses) versus percentage of accumulative area of porosity in cross-sectional plane.



2219-T87 (0.50 in. = 1.27 cm plate) cross-sectional plane.



2219-T87 (all three thicknesses)
-sectional plane.

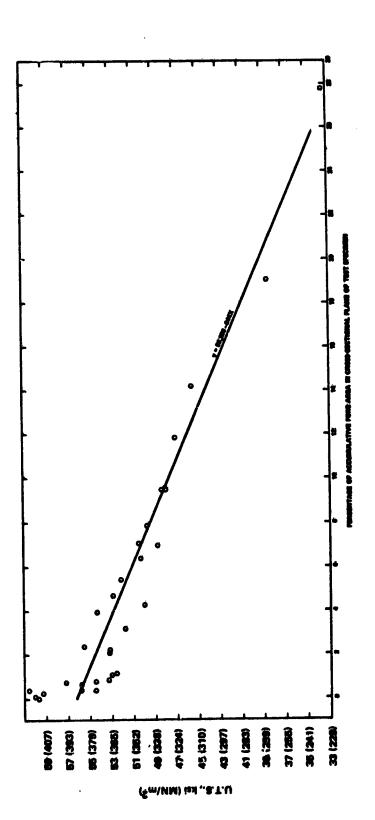


Figure 15. Cryogenic (-320°F = 196°C ultimate tensile strength of flush bead TIG weldments in alloy 2014-T651 (0.250 in. = 0.635 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane.

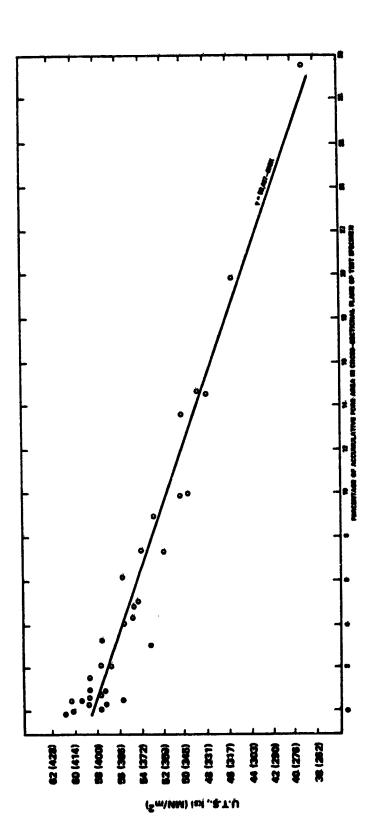


Figure 16. Cryogenic (-320° F = -196°C) ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.250 in. = 0.635 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane.

In general, accumulative pore area and percent pore area in weldments of each alloy displayed a very strong linear relationship with ultimate tensile strength. Simple straight line regression analysis yielded correlation coefficients (r) which exceeded -0.900, and the square of the coefficients (r2) was in excess of the numerical value of 0.81. In essence, this means that more than 81 percent of the total ultimate tensile strength variation can be explained by the associated accumulative pore area or percent pore area. In some cases, the correlation coefficients actually surpassed the numerical value of -0.980. These two quantities are grouped together because percent pore area is only a slight mathematical refinement of accumulative pore area. Percent pore area by this method of calculation takes into account the small change in crosssectional area from specimen-to-specimen. The maximum allowable percentage of porosity for the worst single linear inch of weld permitted by MSFC specifications 259A and 504 [7, 10] are shown for each thickness in the plots of Figures 7, 8, 9, 11, 12, and 13. These allowables represent the worst single inch in six continuous linear inches of weld in the case of 259A, and the worst one inch in three continuous linear inches of weld in the case of 504.

Accumulative pore volume per unit length of weld is also shown to be an excellent indicator of tensile strength. Overall, these correlation coefficient values were slightly lower than those values which were obtained by using the pore area concept.

The linear relationship between ultimate tensile strength and accumulative linear inch of porosity per unit length of weld was the weakest, as indicated by the resultant correlation coefficients. The coefficients varied from -0.591 to -0.872, with a majority of the values in the -0.750 range. Therefore, the accumulative linear inch concept is not considered as a good indicator to describe the effect of porosity upon weld joint strength degradation.

The ultimate tensile strength for each individual value (all thicknesses combined) was plotted as a function of corresponding percent pore area for each alloy (Figs. 10 and 14). These combined data exhibited a correlation coefficient of -0.882 for weldments of aluminum alloy 2014-T6, and a coefficient of -0.913 for weldments of alloy 2219-T87.

Tensile tests conducted at -320° F (-196°C) with 1/4-in. (0.635-cm) plate weldments also showed a strong linear relationship between ultimate tensile strength and accumulative simulated pore area or percent pore area (Figs. 15 and 16). Simple straight line regression analysis resulted in a correlation coefficient of approximately -0.94 for both alloys. Tensile strength as a function of accumulative pore volume showed a correlation coefficient greater than

-0.88 for both alloys; whereas, using the accumulative linear inch concept, the coefficients were -0.799 and -0.708 for alloy 2014-T6 and alloy 2219-T87, respectively. The resultant correlation coefficients are shown in Tables 5 and 6.

Remarkably, the linear relationship between ultimate tensile strength and accumulated pore area held from 0 to 30 percent pore area at room temperature and from 0 to 15 percent pore area at -320°F (-196°C). These were the highest values of pore area tested and did not necessarily represent a limiting pore area. Another fact which is obvious from reviewing Figures 7 through 16 is that the ultimate strength is reduced linearly to 63 percent of its initial value at 30 percent pore area (70 percent gross cross section of weld metal remaining). This indicates the toughness of these welds in the presence of spherical porosity.

CONCLUSIONS

Tensile properties in defect-free, weldments of aluminum alloy 2014-T6 or 2219-T87 (sheet and plate) are shown to be related to the level of induced simulated porosity. The scatter diagram (strength-porosity graph) showed that the ultimate tensile strength of the weldments displayed the most pronounced linear relationship with the level of porosity. (Yield strength and elongation decreased rapidly at high pore concentrations).

Accumulative pore area or percent pore area displayed the best linear relationship with ultimate tensile strength. Accumulative pore volume also displayed a strong relationship with ultimate tensile strength; whereas, accumulative linear pore diameters indicated a relatively weak relationship with weld strength.

Simple straight line regression analysis of tensile data (considering all thicknesses) showed that (a) 81 to 97 percent of the total ultimate tensile strength variation can be explained by the associated accumulative pore area concept, (b) 76 to 91 percent of the total ultimate tensile strength variation can be attributed to the associated accumulative pore volume, and (c) only 34 to 76 percent of the total ultimate tensile strength variation can be attributed to the associated linear accumulation of pore diameters. Tensile tests conducted at -320°F (-196°C) displayed similar linear trends between corresponding variables.

In summation, the selected relationship between weldment ultimate tensile strength and accumulative pore area may be treated as linear, provided only those pores which pass through the fracture path are considered for correlation purposes. However, the linear relationship holds to much greater pore concentrations than are curently allowed. Other internal defects, such as fissure, dross, sharp tails, lack of fusion, and impure weld metal, will undoubtedly affect the strength of the weld but were avoided to obtain the correlation of spherical-type porosity. Nevertheless, this relationship based on accumulative pore area, as detected by radiographic techniques, in combination with known design load requirements will serve as an engineering guideline in determining when a weld repair is necessary or when porosity is acceptable. In addition, this same relationship makes possible an assessment of existing radiographic acceptance standards, and it has been applied to determine the porosity levels in MSFC-SPEC-504.

TABLE 5. THE RELATIONSHIP BETWEEN TRANSVERSE WELDMENT ULTIMATE TENSILE STRENGTH AND PORE CONCENTRATION FOR ALLOY 2219-T87

Base Material	Specia	men	Correla	ation Coeffici	ent (r)	· · · · · · · · · · · · · · · · · · ·
Thickness	Width		Accumu-	Accumu-	Percent	Accumu-
Inch (cm)	Inch (cm)	lative Pore	lative Pore	of	lative Linear
			Volume	Area vs.	Accumu-	Pore Dia.
			vs. UTS	UTS	lative	vs. UTS
					Pore	
					Area vs.	
					UTS	
0.125 (0.318)	1.0	(2.54)	-0. 933	-0.966	-0.966	-0. 643
0.250 (0.635)	0.250	(0.635)	-0.937	-0.981	-0.981	-0.779
0.250 (0.635)	0.50	(1.27)	-0. 953	-0.984	-0.984	-0.715
0.250 (0.635)	0.50	(1.27)	-0.948*	-0.990*	-0.992*	-0.708*
0. 250 (0. 635)	1.00	(2.54)	-0.930	-0.972	-0.981	-0. 673
		·	ľ		(-0.980**	
0.500 (1.27)	1.00	(2.54)	-0. 875	-0.903	-0.917	-0.726
Using Ambient						
Temperature U	TS					
Results from al					-0. 913	
Thicknesses an		ıs			0.010	

^{*---}Tensile tests conducted at -320°F (-196°C).

NOTES: 1. Tensile specimens were made from TIG weldments containing 2319 filler metal.

- 2. Weld beads were removed until flush with base metal surface.
- 3. Percent pore area was calculated by taking the accumulative pore area and dividing by the cross-sectional area of the tensile specimen X100.
- 4. Accumulative linear inch of pores was arrived by the summation of pore diameters.
- 5. The pore diameters ranged from 0.009 inch (0.023 cm) to 0.203 inch (0.514 cm).
- 6. The pore concentrations ranged as follows:
 - m. Accumulative pore volume was 0 to 0.135 cubic inches (0 to 0.221 cm³).
 - b. Accumulative pore area was 0 to 0.094 square inch (0 to 0.607 cm²).
 - c. Percent of accumulative pore area was 0 to 30.1.
 - d. Accumulative linear pores was 0 to 0.573 (0 to 1.455 cm).

^{**---}This coefficient was obtained by using all the ambient temperature tensile results from 0.250-inch (0.635-cm) plate; this would include the results from 0.250-in. (0.635-cm), 0.50-in. (1.27-cm) and 1.00-in. (2.54-cm) wide tensile spec ins.

TABLE 6. THE RELATIONSHIP BETWEEN TRANSVERSE WELDMENT ULTIMATE TENSILE STRENGTH AND PORE CONCENTRATION FOR ALLOY 2014-T6

Base Material	Specimen	Corre	elation Coeffi	cient (r)	
Thickness Inch (cm)	Width Inch (cm)	Accumu- lative Pore	Accumu- lative Pore	Percent of	Accumu-
men (em)	men (em)	Volume vs. UTS	Area vs. UTS	Accumu- lative Pore Area vs.	lative Linear Pore Dia. vs. UTS
0.107 (0.272) 0.250 (0.635) 0.250 (0.635) 0.250 (0.635) 0.250 (0.635) 0.500 (1.27)	0.50 (1.27)	-0. 909 -0. 891 -0. 901 -0. 885* -0. 890	-0. 943 -0. 956 -0. 953 -0. 939* -0. 950	-0. 945 -0. 956 -0. 952 -0. 939* -0. 952 (-0. 953**) -0. 885)	-0. 698 -0. 872 -0. 787 -0. 799* -0. 759
Using Ambient UTS Résults fro Thicknesses an	Temperature om all			-0.882	

^{*---}Tensile tests conducted at -320°F (-196°C).

NOTES: 1. Tensile specimens were made from TIG weldments containing 4043 filler metal.

- 2. Weld beads were removed until flush with base metal surface.
- 3. Percent pore area was calculated by taking the accumulative pore area and dividing by the cross-sectional area of the tensile specimen X100.
 - 4. Accumulative linear inch of pores was arrived by the summation of pore diameters.
 - 5. The pore diameters ranged from 0.009 inch (0.023 cm) to 0.203 inch (0.514 cm).
 - 6. The pore concentrations ranged as follows:
 - a. Accumulative pore volume was 0 to 0.025 cubic inches (0 to 0.412 cm³).
 - b. Accumulative pore area was 0 to 0.181 square inch (0 to 1.168 cm²).
 - c. Percent of accumulative pore area was 0 to 36.1.
 - d. Accumulative linear pores was 0 to 1.107 inch (0 to 2.182 cm).

^{**---}This coefficient was obtained by using all the ambient temperature tensile results from 0.250-inch (0.635-cm) plate; this would include the results from 0.250-in. (0.635-cm), 0.50-in. (1.27-cm) and 1.00-in. (2.54-cm) wide tensile specimens.

APPENDIX DATA FOR TENSILE STRENGTH MEASUREMENTS OF ALUMINUM ALLOY SPECIMENS

TABLE A-1. FLUSH BEAD TENSILE RESULTS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (4043 FILLER METAL) IN 0.107 INCH (0.272 CM) SHEET ALUMINUM ALLOY 2014-T6

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CROSS— SECTIONAL PERCENT PORE AREA	0	0.78	1.502	2238	2.896	3.647	4.358	4.784	0.34	1.362	2.381	3.383	951	5.437	6.422	7.484	8.616	928'0	3.194	5.571	7.713	10.069	12.327	1.443	4277	7.16	1666	12.943	15,802	2.321	9.302	16.278	23.18	3.307	6.48	166	13.199	16.643
ACCUMULATIVE PORE AREA INCHES ² (cm ²)	0	0.00069 (0.00445)	0.00138 (0.0009)	0.00207 (0.01335)	0.00276 (0.01781)	0.00345 (0.02228)	0.00414 (0.02671)	0.00455 (0.02935)	0.00032 (0.00203)	0.00126 (0.00613)	0.00221 (0.01428)	0.00315 (0.02032)	0.0041 (0.02645)	0.00504 (0.03252)	0.00599 (0.03865)	0.00693 (0.04471)	0.00788 (0.05084)	0.00073 (0.00468)	0.0029 (0.01671)	0.00508 (0.03277)	0.00725 (0.04677)	0.00943 (0.06084)	0.0116 (0.07484)	0.00134 (0.00865)	0.00401 (0.02587)	0.00668 (0.0431)	0.00935 (0.06:32)		0.0147 (0.09484)	0.00217 (0.014)	0.00869 (0.05606)	0.0152 (0.09806)	0.02172 (0.14013)	0.00304 (0.01961)	0.00608 (0.03923)	0.00912 (0.05884)	0.01216 (0.07845)	0.0152 (0.09806)
ACCUMULATIVE PORE VOLUME INCHES ³ (œ).	0	0.00000622 (0.0001019)	0.00001244 (0.0002039)	0.00001868 (0.0003058)	0.00002488 (0.0004077)	(9605000.0) 1160000.0	0.00003732 (0.00061:6)	0.00004105 (0.0006727)	0.000000407 (0.0000687)	0.00001629 (0.0002689)	0.0000285 (0.000467)	0.00004072 (0.0006673)	0.00005294 (0.0008675)	0.00006515 (0.0010676)	0.00007737 (0.0012679)	0.00008958 (0.001468)	0.0001018 (0.0016682)	0.00001565 (0.0002565)	0.0000626 (0.0010258)	0.0001096 (0.001796)	0.0001565 (0.0025646)	0.0002035 (0.0033348)	0.0002504 (0.0041033)	0.00003882 (0.0006361)	0.0001165 (0.0019091)	0.0001941 (0.0031807)	0.0002717 (0.0044524)	0.0003494 (0.0057256)	0.000:27 (0.0069973)	0.0000082:3 (0.0013459)	0.0003785 (0.0053832)	0.0005749 (3.0094209)	0.0008213 (0.0135487)	0.0001344 (0.0022024)	0.0002668 (0.0043721)	0.0004002 (0.006558†)	0.0005336 (0.0087441)	0.000667 (0.0108302)
ACCUMULATIVE PORE LINEAR INCHES (cm)	0	0.0625 (0.1588)	0.125 (0.3175)	0.1875 (0.4763)		0.3125 (0.7983)		0.4125 1.0478)			0.133 (0.3378)	0.19 (0.4826)	0.247 (0.6274)	0.304 (0.7722)	0.361 (0.9169)	0.418 (1.0617)			0.116 (0.2946)	0.203 (0.5156)	_	0.377 (0.9576)	0.464 (1.1783)	- 1	0.1178 (0.2992)	0.1963 (0.4986)	0.2748 (0.698)	0.3533 (0.8974)	0.4318 (1.0968)	0.06 (0.127)	Ī	0.36 (0.889)	Γ	0.059 (0.1499)	Γ	0:177 (0.4496)	0.236 (0.5994)	0.296 (0.7493)
NUMBER OF PORES	0	2	10	15	8	22	8	33	1	*	7	10	13	16	21	Z	18	-	•	7	10	13	16	1	3	9	7	0	11	-	•	7	5	-	2	2	•	9
PORE DIAMETER NCHES (cm)	0	(0125 (0.0318)	1,0125 (0,0318)	10125 (0.0318)	.0125 (0.0318)	ı	(9125 (0.0318)	0125 (0.0318)		(0.0483)	(0.0483)	(0.0483)		(0.0483)	(0.0483)	l			(0.0737)	Ι.		1	_	1	_		- 1	- 1	23	1.05 (0.127)	.05 (0.127)	l	0.05 (0.127)	069 (0.15)	1	.069 (0.15)		£069 (0.15)
ELONGATION IN 2 INCH '.á.08 cm) GAGE ILENGTH, PERCENT	2.0	2.0	1.3	٥	1.5	•	-	1.0	22 0.	22 0.	1.5	1.5	-	٦	-	-	-	-		1.2 0.	٦	-	Ĕ			1.3 0.) I	1.5	D 80	-	1.3			_		12 0	12 0.	1.2
YS, 62% OFFSET KSI (MN/m ²)	36.09 (246.83)	35.01 (241.39)		1	1		1	36.60 (252.35)	38.80 (253.73)		37.24 (256.76)	ı	1		36.56 (252.07)		35.29 (243.42)	1 -	35.30 (243.39)	35.00 (241.32)	34.84 (240.21)	34.48 (237.73)	33.28 (229.46)		35.94 (247.80)	36.25 (249.94)	(92792) EY'9E	34.97 (241.11)	34.86 (239.11)	200	35.35 (243.73)		1	35.37 (243.87)	1	34.07 (234.91)	32.84 (226.43)	32.51 (224.15)
U. T. S., KSI (MN/m²)	47.36 (326.47)	46.06 (317.57)	(294.13)	(291.58)	(290.96)	(236.20)	(292.13)	(292.68)	_	(304.34)	(281.31)	(284.69)	(287.72)	(277.03)	(289.10)	(275 03)	(57 29)	(322,13)	(256.31)		(274.21)	37.26 (256.90)	34.80 (239.94)	(319.85)	(289,72)	(282.58)	(273.65)	(267.93)	38.85 (267.86)	(306,30)	38.74 (267.10)	(256.21)	(241.25)	(288.62)	(273.93)	37.88 (261.18)	37.02 (255.25)	34.14 (249.18)

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TABLE A-1. (Concluded)

CROSS-SECTIONAL PERCENT PORE AREA	22.278 28.512 4.036 9.331 14.177 14.177 15.864 23.144 12.076 12.076 12.076 30.778 36.62	
ACCUMULATIVE PORE AREA INCHES ² (cm ²)		
ACCUMULATIVE PORE VOLUME INCHES ³ (cc)	0.0008338 (0.0153022) 0.001067 (0.017485) 0.0004672 (0.002328) 0.0004672 (0.007856) 0.0006344 (0.0114841) 0.0006344 (0.0191401) 0.000634 (0.0191401) 0.001402 (0.0229747) 0.001635 (0.0229747) 0.001635 (0.0172084) 0.00105 (0.0172084) 0.00105 (0.0172084) 0.001751 (0.0228419) 0.001751 (0.0238419)	T RESULTS.
ACCUMULATIVE PORE LINEAR INCHES (cm)		DE.
NUMBER AC OF P PORES		NE INCH WE
PORE DIAMETER INCHES (cm)	0.000 (0.204) 0.000 (0.15) 0.007 (0.178) 0.07 (0.178) 0.07 (0.178) 0.07 (0.178) 0.07 (0.178) 0.007 (0.178) 0.000 (0.204) 0.0000 (0.204) 0.0000 (0.204)	CIMENS WERE COWN IS THE AVE
ELONGATION IN 2 INCH (5,03 cm) G/GE LENGTH, PER:ENT	12 1 12 1 12 1 12 1 12 1 12 1 12 1 12	ALL TENSILE ST EACH VALUE ST
Y.S., 6.2% OFFSET KSI (MN/m ²)	21.00 12.00	MOTES: (1) A
U. T. S., KSI (MN/m ²)	(279.28) (223.38) (223.38) (227.38) (227.38) (227.38) (227.38) (227.38) (227.38) (237.28) (213.28) (213.28)	
36	amping pangang and 111.	<u> </u>

TABLE A-2. FLUSH BEAD TENSILE RESULTS FOR 0.250 IN. (0.635 CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (4043 FILLER METAL) IN 0.250 IN. (0.635 CM)
PLATE ALUMINUM ALLOY

CROSS— SECTIONAL PERCENT PORE AREA	9	0.1056	0.2074	0.3104	0.417	0.5211	0.614	0.7257	0.8376	0.3812	0.7591	1.1401	1.5005	1.8779	2.2652	2.1462	4.3066	6.4896	4.7496	9.4724	7.8732	15,7986	13.7181	19.13.3	28.8402						
ACCUMULATIVE PORE AREA INCHES ² (cm ²)	0	0.000066 (0.000420)	0.000132 (0.000852)	0.000198 (0.001277)	0.000264 (0.001703)	0.00033 (0.002129)	0.000396 (0.002555)	0.000462 (0.002981)	0.000528 (0.003406)	0.00024 (0.001548)	0.00048 (0.003097)	0.00072 (0.004645)	0.00096 (0.006194)	0.0012 (0.007742)	0.00144 (0.00929)	0.001368 (0.908826)	0.002736 (0.017652)	0.004104 (0.26477)	0.003007 (0.0194)	0.006014 (0.0388)	0.00500£ (0.03229)	0.01001 (0.06458)	0.008652 (0.055819)	0.01218 (0.07858)	0.01793 (0.11568)						
ACCUMULATIVE PORE VOLUME INCHES ³ (cc)	0	0.000000603 (0.00000988)	0.600001206 (0.00001976)	0.000001809 (0.00002964)	0,000002412 (0.00003953)	0.000003015 (0.00004941)	0.000003618 (0.00005929)	0.000004221 (0.00006917)	0.000004824 (0.00007905)	0.000002881 (0.00004721)	0.000005762 (0.00009442)	0.000008643 (0.00014163)	0.000011413 (0.00018884)	0.000014405 (0.00023606)	0.000017286 (0.00028327)	0.000039 (0.0006391)	0.000078 (0.0012782)	0.000117 (0.0019173)	0.0001389 (0.0022762)	0.0002778 (0.0045523)	0.0002856 (0.0046801)	0.0005712 (0.0093603)	0.000661 (0.0108318)	0.001078 (0.0176653)	0.001946 (0.0318892)						
ACCUMULATIVE: PORE LINEAR INCHES (cm)	0	0.009 (0.6229)	0.018 (0.0457)	0.027 (0.0686)	0.036 (0.0914)		2		┪		┪		┪	2	0.099 (0.2515)			٦			<u>~</u>		8	┪	0.1455 (0.3696)			RESULTS.			
NUMBER OF PORES	0	1	2	3	4	5	9	7	8	-	2	3	4	5	9	1	2	3	1	2	1	2	1	1	1			MORE TEST RESULTS.			
PORE DIAMETER INCHES (cm)	0	0.009 (0.0229)	0.009 (0.0229)	0.009 (0.0229)	0.009 (0.0229)	0.009 (0.0229)	0.009 (0.0229)	0.009 (0.0229)	0.009 (0.0229)	0.0165 (0.0419)	0.0165 (0.0419)	0.0165 (0.0419)	0.0165 (0.0419)	0.0165 (0.0419)	0.0165 (0.0419)	0.039 (0.0991)	0.039 (0.0991)	0.039 (0.0991)	0.059 (0.15)	0.059 (0.15)	0.0765 (0.1943)	0.0765 (0.1943)	0.1005 (0.2553)	0.12 (0.3048)	0.1455 (0.3696)			E OF THREE OR			
ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	3.1	2.3	2.3	2.3	1,8	1.5	2.0	1.7	2.0	2.3	2.5	1.8	2.2	2.3	1.8	2.3	2.2	2.0	2.3	1.8	2.3	1.9	1.2	1.5	1.0			IS THE AVERAG			
Y. S., 0.2% OFFSET KS! (MN/m ²)	36.81 (253.80)	37.04 (255.38)	36.32 (250.42)	36.66 (252.76)	36.68 (252.90)	37.14 (256.07)	36.43 (231.18)	36.47 (251.45)	36.42 (251.11)	36.77 (253.52)	36.20 (249.59)	36.12 (249.04)	35.48 (244.63)	36.52 (251.80)	35.99 (248.14)	36.62 (252.49)	36.63 (252.56)	36.10 (248.90)	35.73 (246.35)	35.16 (242.42)	33.36 (230.01)	31.17 (214.91)	33.16 (228.63)	30.85 (212.70)	26.75 (184.44)			VALUE SHOWN			
U. T. S., KSI (MN/m²)	50.87 (350.74)	50.21 (346.19)	49.40 (340.60)	47.87 (330.05)	46.67 (321.78)	47.70 (328.88)	48.16-(332.05)	·45.28 (312.20)	46.10 (310.96)	49.00 (337.85)	48.56 (334.81)	47.34 (326.40)	47.60 (328.19)	47.69 (328.81)	45.95 (316.82)	48.17 (332.12)	46.72 (322.13)	44.62 (307.65)	45.32 (312.47)	41.82 (288.34)	41.79 (288.13)	24.87 (240.42)	39.74 (274.00)	37.07 (255.59)	31.19 (215.05)			NOTE: EACH	7		ļ.,

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TABLE A-3. FLUSH BEAD TENSILE RESULTS FOR 0.50-IN. (1.27-CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (4043 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY 2014-T651

and the second of the post of the second of

	* C S S	ELONGATION IN 2 INCH	900	NUMBER	ACCUMULATIVE	ACCUMULATIVE	ACCUMULATIVE	CROSS- SECTIONAL
U.T.S.	OFFSET	(5.08 cm)	DIAMETER		PORE LINEAR	PORE VOLUME	PORE AREA	PERCENT
KSI (Mri/m²)	×	GAGE	iNCHES (cm)	PORES	INCHES (cm)	INCHES ² (cc)	INCHES ⁴ (cm ⁴)	AREA
		PERCENT						
50 97 (350 74)	36.81 (253.80)	3.1	0	°	0	0	ŏ	0
SO 24 (245, 39)	36.86 (254.14)	2.2	0.009 (0.0229)	2		0.000001206 (0.00001976)	0.000132 (0.000852)	0.1045
AG 077 (378, 33)	36.42 (251.11)	20	0.009 (0.0229)	4		0.000002412 (0.00003953)	0.000264 (0.001703)	0.2079
49.25 (340.26)	27 30 (257.18)	2.3	0.009 (0.0229)	9		0.000003618 (0.00005929)	0.000396 (0.002555)	0.3031
46.26 (318.95)	36.98 (254.97)	2.0	0.009 (0.0229)	8		0.000004824 (0.00007905)	0.000528 (0.003406)	0.4148
47 11 (324.81)	36.95 (254.76)	18	0.009 (0.0229)	10		0.00000603 (0.00009881)	0.00066 (0.004258)	0.5136
50.57 (348.67)	36.46 (251.38)	2.2	0.009 (0.0229)	12	0.108 (0.2743)	0.0000007236 (0.0001186)	0.000792 (0.0051)	0.6159
46.38 (319.70)	36.52 (261.87)	1.7	0.009 (0.0229)	14	0.126 (0.32)	0.000008442 (0.0001383)	0.000924 (0.005961)	0.7299
44.76 (308.61)	36.13 (249.11)	3,	0.065 (0.0223)	91	0.144 (0.3658)	0.000009648 (0.0001581)	0.001056 (0.006813)	0.8205
48.83 (336.67)	36.84 (254.00)	3.5	0.0165 (0.0419)	2	0.033 (0.0838)	0.000006762 (0.00009442)	0.00048 (0.003097)	0.3756
47.53 (327.71)	36.65 (252.69)	22	0.0165 (0.0419)	4	0.066 (0.1676)	0.000011524 (0.00018884)	0.00096 (0.006194)	0.7589
47.08 (324.61)	36.94 (254.69)	20	0.0165 (0.0419)	9	0.099 (0.2515)	0.000017286 (0.00028327)	0.00144 (0.00929)	1.1259
(1316.61)	36.28 (250.14)	25	0.0165 (0.0419)	8	0.132 (0.3353)	0.000023048 (0.0003777)	0.00192 (0.01239)	1.490/
5 (20164)	36.54 (251.94)	22	0.0165 (0.0419)	10	0.165 (0.4191)	0.00002881 (0.0004721)	0.0024 (0.01548)	1.8663
47 34 (326.40)	36.47 (251.45)	20	0.0165 (0.0419)	12		0.000034572 (0.0005665)	0.00288 (0.01858)	2.243
47 47 (327 30)	36.97 (254.90)	22	0.039 (0.0991)	ı	0.039 (0.0991)	0.000039 (0.0006391)	0.001368 (0.008826)	1.0806
45 92 (316.51)	36.63 (252.56)	23	0.039 (0.0991)	2	0.078 (0.1981)	0.000078 (0.0012782)	0.002736 (0.017652)	2.1325
46.43 (320.13)	36.94 (254.69)	23	0.039 (0.0991)	8	0.117 (0.2972)	0.000117 (0.0019173)	0.004104 (0.026477)	3.2571
45.24 (311.92)	36.59 (252.28)	20	0.039 (0.0991)	*	0.156 (0.3962)	0.000156 (0.0025564)	0.005472 (0.035303)	4.2884
44.89 (309.51)	36.07 (249.70)	2.3	0.039 (0.0991)	9	0.195 (0.4953)	0.000195 (0.0031955)	0.00684 (0.044129)	5.3083
44.03 (303 FR)	Se 20 (245.65)	2.0	0.039 (0.0991)	9	0.234 (0.5944)	0.000234 (0.0038346).	0.008208 (0.052955)	0.42/6
46.90 (223.37)	36.48 (251.52)	2.5	0.059 (0.15)	-	0.059 (0.1499)	0.0001389 (0.0022762)	0.003007 (0.0194)	3406
44.58 (307.37)	35.69 (246.68)	2.5	0.059 (0.15)	2	0.118 (0.2997)	0.0002778 (0.0045523)	0.006014 (0.0368)	4.7429
44.30 (305.44)	35.23 (242.90)	2.5	0.059 (0.15)	3	0.177 (0.4496)	0.0004167 (0.0068285)	0.009021 (0.0582)	/00n./
41.86 (288.62)	36.55 (245.11)	1.7	0.059 (0.15)	4	0.236 (0.5994)	0.0005555 (0.0091047)	0.012028 (0.0776)	20120
46.59 (314.33)	34.92 (240.77)	2.5	0.0765 (0.1943)	-	0.0765 (0.1943)	0.0002856 (0.0046801)	0.000000 (0.03223)	7.8571
43.23 (298.06)	34.16 (235.53)		0.0765 (0.1943)		0.153 (0.3886)	0.0005/14 (0.0053603)	0.016015 (0.06821)	11.6848
40.72 (280.77)	34.21 (235.87)	1	0.0765 (0.1543)	\$	0.4000 (0.3023)	0.000661 (0.0108318)	0.008652 (0.055819)	6.7752
43.52 (300.06)	25.02 (241.46)	100	(5002.0) CUUT.0	- 6	0.201 (0.5105)	0.001322 (0.021664)	0.017304 (0.111638)	13.4766
(87.7/2) (2.08	32.30 (27.23)	9.00	0 12 (0 2040)	-	0 12 (0 3048)	0.001078 (0.0176653)	0.01218 (0.07858)	9.583
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	21 50 (242 40)	1.5	0 12 (0 3048)	2	0.14 (0.6096)	0.002156 (0.035331)	0.02436 (0.15716)	19.2569
38 65 (265 65)	2 TS (275 RG)	1.3	0.1455 (0.3896)	-	0.1455 (0.36961	0.001946 (0.0318892)	0.01793 (0.11568)	14.107
165.7160	28 92 (199 40)	1.0	: 2 :455 (0.3696)	2	0.291 (0.7391)	0.003892 (0:063778)	0.03586 (0.23135)	28.4603
NOTE		EACH VALUE SHOWN IS THE ANE	ERAGE OF THRE	E OR MORE	TEST RESULTS.			

1 3 110 11

TABLE A-4. FLUSH BEAD TENSILE RESULTS FOR 1.00-IN. (2.54-CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (4043 FILLER METAL) IN 0.250 IN. (0.635 CM)

ALUMINUM ALLOY 2014-T651

Į									33000
			ELONGATION	300	AUMARR	ACCUMINATIVE	ACCUMULATIVE	ACCUMULATIVE	SECTIONAL
	+	Y. S. J.Zh C.CESET	(5 08 cm)	DIAMETER		PORE LINEAR	PORE VOLUME	PORE AREA	PERCENT
	KSI (MN/m²)	<u>~~</u>	GAGE LENGTH,	INCHES (cm)	PORES	INCHES (cm)	INCHES ³ (œ)	INCHES ² (cm ²)	PORE
			PERCENT			ļ		c	°
<u> </u>	50.87 (350.74)	36.81 (253.80)	3.1	0	۷	0.045 (0.1142)	0 000003015 (0.00004941)	0.00033 (0.002129)	0.1318
	49.04 (338.12)	37.01 (255.18)	2.8	0.009 (0.0229)	0	0.045 (0.1745)	0.00000603 (0.00009881)	0.00066 (0.004258)	0.265
	46.77 (322.47)	36.62 (252.49)	2.2	0.009 (0.0229)	01	0.03 (0.4200)	0.00009045 (0.00014822)	0.00099 (0.006387	0.3933
_	45.10 (310.96)	37.22 (256.62)	2.2	0.009 (0.0229)	2 8	0 19 (0 4572)	0.00019763)	3.00132 (0.008514,	0.5134
L L	46.35 (319.57)	36.56 (252.07)	23	0.009 (0.0229)	3 8	0.10 (0.45) 2/	0.00015075 (0.00024703)	0.00165 (0.010645)	0.6643
	46.64 (321.57)	36.62 (252.49)	2.0	0.009 (0.0229)	8 8	0.72.10.09591	0 00001809 (0.00029644)	0.00198 (0.012774)	0.782
[] 3	48.93 (337.36)	36.50 (251.66)	2.7	0.009 (0.0229)	3 8	0.27 (0.0630)	000032609)	0.002178 (0.014052)	0.8471
	6.44 (320.19)	36.40 (250.97)	2.3	0.009 (0.0229)	3	0.437 (0.7344)	0.00002881(0.000047211)	0.00024 (0.0015484)	0.09415
	48.76 (336.19)	36.59 (252.28)	2.0	0.0165 (0.0419)	-	0.0100 (0.0413)	0 000011524 (0 00018884)	0.0006 (0.006194)	0.3811
	47.38 (326.68)	38.66 (266.55)	2.2	0.0165 (0.0419)	4	0.000 (0.10/0)	0.00033167 (0.00033048)	0.00168 (0.010839)	0,6677
Ľ	47.45 (327.16)	37.78 (260.49)	23	0.0165 (0.0419)	,	0.1150 (0.4854)	0.00002010 10.004721)	0.0024 (0.01548)	0.9471
	46.33 (319.44)	36.34 (250.56)	2.0	0.0165 (0.0419)	9	0.165 (0.4191)	0.00002881 (0.0004)21)	0 00010 (0 000100)	1.246
17	66.03 (317.37)	36.99 (255.04)	2.0	0.0165 (0.0419)	13	0.2145 (0.5448)	0.00037453 (0.0006137)	0.00012 (0.020123)	1 5317
	(E.11 (317.92)	37.78 (260.49)	2.2	0.0165 (0.0419)	16	0.264 (0.6706)	0.000046056 (0.000/554)	0.00456 (0.006410)	1 ROBB
1	EK 35 (312.68)	37.65 (259.59)	1.7	0.0165 (0.0419)	9	0.3135 (0.7963)	0.000054739 (0.000697)	C.Compa Journal	2,000
1	(36 600) 30 77	36 (12 48 21)	2.0	0.0165 (0.0419)	Z	0.363 (0.922)	0.000063382 (0.0010386)	0.00528 (0.034064)	2 2002
Τ,	AS (320 26)	27 06 (255 52)	2.3	0.0165 (0.0419)	92	0.4125 (1.0478)	0.000072025 (0.0011803).	0.006 (0.038/1)	4.50
1	40 27 (36 36)	25, 98 (754, 78)	20	0.039 (0.0991)	1	0.039 (0.0991)	0.000039 (0.0006391)	0.001368 (0.008826)	40000
1	48 21 (218 R1)	26 60 (25,25)	22	0.039 (0.0991)	3	0.117 (0.2972)	0.000117 (0.0019173)	0.004104 (0.025477)	0.35.56
.1.	46.62 (321.44)	36,28 (250.14)	2.2	0.039 (0.0991)	Ω	0.195 (0.4953)	0.000195 (0.0031955)	0.00684 (0.044729)	2.7020
1	16 21 (30 E 2)	25 50 (245 30)	2.0	0.039 (0.0991)	7	0.273 (0.6934)	Ę,	0.035/610.061/61/	
· [*	43 B1 (302.06)	36.59 (252.28)	1.8	0.039 (0.0991)	8	0.312 (0.7925)	ìo.	0.010944 (0.070695)	4,200
T,	43.34 (298.82)	36.26 (250.01)	2.0	0.039 (0.0991)	6	0.351 (0.8915)	0.000351 (0.0k o.19)	0.012312 (0.01302)	
17	43.83 (302.20)	36,63 (252.56)	2.0	0.039 (0.0991)	10	0.39 (0.9906)	0.00039 (0.006391)	0.01.00 10.000200	
Ľ	43.53 (300.13)	35.43 (244.28)	20	0.039 (0.0991)	11	0.429 (1.0897)	0.000429 (0.00703)	(00000100000000000000000000000000000000	L
1	44.18 (304.61)	36.52 (244.90)	2.5	0.039 (0.0991)	12	0.468 (1.1887)	0.000468 (0.00/668)	0.013007 (0.0194)	
Ľ	48.23 (332.54)	37.37 (257.66)	2.7	0.059 (0.15)	-	0.059 (0.1489)	0.0001363 10.0022735	0 000014 (0.0388)	2,3686
1	46.13 (311.16)	37.05 (255.45)	2.5	0.059 (0.15)	2	0.113 (0.2997)	0.0002178 (0.0003323)	0.009027 (0.0582)	3.6775
ַ	44.63 (307.71)	37.30 (257.18)	2.7	0.059 (0.15)	3	0.177 (0.4496)	0.000 18/ (0.000223)	0.012028 (0.0776)	4.7882
<u>. </u>	43.90 (302.68)	36.80 (253.73)	2.5	0.059 (0.15)	4	0.236 (0.5994)	0.0005004 (0.0031001)	0.015035 (0.0967)	5.971
<u></u>	42.75 (294.75)	35.38 (243.94)	2.0	0.059 (0.15)	2	0.295 (0.7493)	0.0000304.10.0136571	0.018042 (0.1164)	7.1368
3	42.72 (294.55)	35.16 (242.42)	2.7	0.059 (0.15)	9	0.354 (0.8592)	0.0005354 (0.015057)	0.021049 (0.1358)	8,3329
_	43.50 (299.92)	35.47 (244.56)	2.2	0.059 (0.15)	7	0.413 (1.049)	0.0009723 (0.015533)	0.024056 (0.1552)	9.546
Ľ	42 01 (289.65)	35.07 (241.80)	22	0.059 (0.15)	8	0.472 (1.1989)	0.0011112 (0.018209)	0 005005 (0.03229)	1,9885
T,	(00 100) WE AN	36.52 (251.80)	25	0.0765 (0.1943)	-	0.0765 (0.1943)	0.0002856 (0.0046501)	003001 (0 06469)	4.0217
⊥.	44 72 (308 34)	+	20	0.0765 (0.1943)	2	0.153 (0.3886)	0.0005712 (0.0093803)	0.01001 (0.00530)	
1	(300 E4) TY	+-	2.2	0.0765 (0.1943)	3	0.2295 (0.5829)	0.0008565 (0.01404)	N. 0.00.00 (0.00.00)	
`	A1 98 (289 31)	+	7.7	0.0765 10.1943)		0.306 (0.7772)	0.0011414 (0.01872)	0.02204 10.1251011	
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TABLE A-4. (Concluded)

		1
CRPSS- SECTIONAL PERCENT PORE AREA	9.9821 12.1727 3.4663 7.0199 10.227 13.7061 16.9514 4.8333 4.8333 4.8333 4.8333 4.8333 1.6528 1.6528 21.6528 22.4829	
ACCUMULATIVE PORE AREA INCHES ² (cm ²)	0.025025 (0.161451) 0.03003 (0.193742) 0.008652 (0.055819) 0.017304 (0.111638) 0.034608 (0.273077) 0.04326 (0.273026) 0.01218 (0.07858) 0.034608 (0.273077) 0.04326 (0.273027) 0.04372 (0.31432) 0.05888 (0.23135) 0.07772 (0.46271)	
ACCUMULATIVE PORE VOLUME IKCHES ³ (cc)	0.001428 (0.0224) 0.0017136 (0.02808) 0.000661 (0.0108318) 0.001322 (0.021684) 0.001983 (0.024.%) 0.00264 (0.04327) 0.002306 (0.064189) 0.002306 (0.064189) 0.002304 (0.052898) 0.002306 (0.052898) 0.002308 (0.052898) 0.003312 (0.052898) 0.003304 (0.052898) 0.003304 (0.052898) 0.003304 (0.052898)	
ACCUMULATIVE PORE LINEAR INCHES (cm)	7765 (0.1943) 5 0.3825 (0.9716) 7765 (0.1943) 6 0.469 (1.1659) 7706 (0.2553) 1 0.1006 (0.2553) 7006 (0.2553) 2 0.2017 (0.5106) 7005 (0.2553) 3 0.3015 (0.7658) 7005 (0.2553) 4 0.402 (1.0211) 7006 (0.2553) 5 0.3015 (0.7658) 72 (0.3048) 1 0.12 (0.3048) 73 (0.3048) 2 0.24 (0.6096) 74 (0.3048) 3 0.4455 (0.3048) 75 (0.3048) 3 0.4455 (0.3086) 76 (0.3089) 3 0.4455 (0.3089) 77 (0.3089) 3 0.4455 (0.3089) 78 (0.3089) 3 0.4455 (0.3089) 79 (0.3089) 4 0.552 (1.4783) 70 (0.3089) 4 0.552 (1.4783) 71 (0.3089) 4 0.552 (1.4783) 72 (0.3089) 7 PREE OR MORE TEST RESULTS.	
NUMBER OF PORES	5 7 7 7 3 3 7 7 7 7 7 7 7 7 7 7 7 7 7 7	
PORE DIAMETER INCHES (cm)	0.0765 (0.1943) 0.0765 (0.1943) 0.1006 (0.2553) 0.1005 (0.2553) 0.1005 (0.2553) 0.12 (0.2048) 0.12 (0.3048) 0.1455 (0.3696) 0.1455 (0.3696) 0.1455 (0.3696)	
ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	25 22 23 22 20 20 1.3 1.8 1.8 1.8 1.8 1.8 1.7 1.3	
Y. S., 0.2% OFFSET KSI (MN/m ²)	36.58 (245.32) 36.70 (242.70) 36.84 (251.59) 34.84 (257.24) 34.35 (237.04) 33.36 (230.84) 33.48 (230.84) 33.48 (230.84) 33.48 (230.84) 33.48 (230.84) 33.48 (230.84) 33.48 (230.84) 33.48 (230.84) 33.48 (230.84) 33.48 (230.84) 33.48 (230.84)	
U. T. S KSI (MN/m²)	42.81 (295.17) 40.16 (176.30) 41.81 (288.77) 41.81 (288.77) 41.81 (288.77) 41.81 (288.77) 42.96 (286.01) 42.96 (286.01) 42.96 (286.01) 42.96 (286.17) 42.96 (286.17) 42.96 (286.17)	

TABLE A-5. TENSILE RESULTS AND CORRESPONDING POROSITY MEASUREMENTS OF T16 WELDMENTS (4043 FILLER METAL) IN 0.50 IN. (1.27 CM) PLATE ALUMINUM ALLOY 2014-T651

	,							
		ELONGATION	1					CROSS-
	Y.S., 0.2%	IN 2 INCH	PORE	NUMBER	ACCUMULATIVE	ACCUMULATIVE PORE YOURSE	ACCUMULATIVE BODE ABEA	PEDIENT
U. T. S.	-	(5.08 cm)	DIAMETER	b	PORT INTER	FORE VOLUME	FORE AREA	בבערבו
KSI (MN/m²)	¥		INCHES (cm)	PORES	INCHES (cm)	INCHES (cc)	INCHES ⁴ (cm ⁴)	PORE
		PERCENT						
En 70 (36) 26)	24 57 (238.35)	51	0	•	c	0	3	သ
	23 00 236		0.0125 (0.0318)	2	0.0625 (0.159)	0.00000622 (0.0001019)	0.00069 (0.0045)	0.171
12 40 PA 24	25.25		0.0125 (0.0318)	92		0.00001244 (0.0002039)	0.00138 (0.0089)	0.282
8	2 3	_	0,0125 (0,0318)	15	Ĭ	0.00001866 (0.0003058)	0.00207 (0.0134)	0.421
	25 25	L	0.0125 (0.0318)	02		0.00002488 (0.0004077)	0.00276 (0.0178)	0.564
2	26.51	3) 3.0	0.0125 (0.0318)	92	_ H	0.0000311 (0.0005096)	0.00345 (0.0223)	0.701
1	8	42	0.0125 (0.0318)	R		0.00003732 (0.0006116)	0.00416 (0.0267)	0.849
47.96 (330.67)	36.45	_	0.0125 (0.0318)	33	0.4125 (1,348)	0.00004105 (0.0006727)	0.00455 (0.0294)	0.928
51.20	24.57	5) 4.3	0.019 (0.0483)	1	(840'0) 610'0	0.00000407 (0.0000667)	0.00032 (0.0021)	0.064
	34.51	4) 3.5	0.019 (0.0483)	٧	0.076 (0.193)	0.00001629 (0.0002669)	0.00126 (0.0081)	0.258
46.92 (323.50)	_	4) 3.5	0.019 (0.0483)	7	0.133 (0.338)	0.0000285 (0.000467)	0.00221 (0.0143)	0.451
46.59 (321.92)	35.12		0.019 (0.0483)	10	0.19 (0.483)	0.00004072 (0.0006673)	0.00315 (0.0203)	0.651
46.69 (321.92)	-	2) 3.3	0.019 (0.0483)	13	0.247 (0.627)	0.00005294 (0.0008675)	0.0041 (0.0265)	0.838
46.89 (316.40)	-		0.019 (0.0483)	16	0.304 (0.772)	0.00006515 (0.0010676)	0.00504 (0.0325)	1.043
46.87 (316.26)	-		6.019 (0.0483)	19	0.361 (0.917)	0.00007737 (0.0012679)	0.00599 (0.0386)	1.243
49.17 (339.01)	3 7		0.019 (0.0483)	72	0.418 (1.062)	0,00008958 (0,001468)	0,00693 (0.0447)	1.43:
47.15 (325.09)	•	9) 3.3	0.019 (0.0483)	25	0,475 (1,207)	0.0001018 (0.0016682)	0.00788 (0.0508)	1.623
46.26 (312.06)	•		0.019 (0.0483)	32	0,608 (1,544)	0.0001303 (0.0021352)	0.01008 (0.065)	2.066
44.41 (306.20)	34.96 (241.18)		0.019 (0.0483)	38	0,722 (1,834)	0.0001547 (0.0025351)	0.01197 (0.0772)	2453
46.02 (310.40)		1) 25	0.019 (0.0483)	*	0.836 (2.123)	0.0001792 (0.0029366)	0.01386 (0.0894)	2.857
44.81 (308.96)	33.41		0.019 (0.0483)	95	0.95 (2.413)	0.0002036 (0.003364)	0.01575 (0.1016)	3.2.4
	34.11		0.029 (0.0737)	1	(1) (0.074)	0.00001565(0.0002565)	0.00073 (0.0047)	0.148
	34.26		0.029 (0.0737)	+	0.116 (0.295)	0.0000626 (0.0610258)	0,0029 (0.0187)	SB:0
	34.38 (237.04)		0.029 (0.0737)	7	0.203 (0.516)	0.0001096 (0.001796)	0.00508 (0.0328)	253
46.53 (313.92)	(32.152) (33.32)		0.029 (0.0737)	10	0.29 (0.737)	0.0001565 (0.0025646)	0.00725 (0.0468)	1.479
46.88 (316.33)	134.18 (236.66)		0.029 (0.0737)	13	0.377 (0.958)	0.0002035 (0.0033348)	0.00943 (0.0608)	1.924
46.71 (315.16)	34.34 (236.77)		0.029 (0.0737)	16	0.464 (1.179)		_	2.63
44.53 (307.03)	1) 35.66 (245.87)	(7) 2.5	0.029 (0.0737)	82	0.58 (1.473)	- 1	0.0	06.7
46.15 (311.30)	35.52 (244.90)		0.029 (0.0737)	8	0.754 (1.915)	0.000407 (0.006669 5)	0.1885 (0.1276)	3.8/1
- 1	35.55		0.029 (0.0737)	g	0.928 (2.357)	0.0005008 (0.008208.)	0.0232 10.14977	4.743
48.95 (344.40)	(0.280) (248.28)		0.0393 (0.0998)	1	0.0393 (0.10)	0.00003882(0.000638)	0.00134 10.0066)	773
47.03 (324.26)	5) 34.17 (236.60)		0.0393 (0.0998)	3	0.1178 (0.299)	0.0003165 (0.0019091,	0.00401 (0.0259)	0.82
46.82 (322.81)	_		0.0383 (0.0998)	2	0.1963 (0.499)	0.0001941 (0.0031807)	0.00668.10.04311	1.362
46.04 (317.44)	_	3.0	(9660'0) 2620'0	7	0.2748 (0.698)	0.0002717 (0.0044524)	0.00935 10.06631	1.912
8.36		3.0	(0.0393 (0.0998)	8	0.3533 (0.897)	0.0003494: (0.0057256)	0.01202 (0.0775)	2.464
46.86 (316.20)		ο ₁ 2.3	0.0393 (0.0989)	11	0.4318 (1.097)	0.000427 (0.0069973)	0.0147 (0.0948)	3.006
45.40 (313.02)			0.0393 (0.0998)		0,5496 (1,396)	0.0005434 (0.0089047)	0.0187 (0.1206)	3.844
43.89 (302.61)		25	0.0393 (0.0998)	18	0.7066 (1.795)	0.0006988 (0.0114513)	0.02405 (0.1552)	4.906

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TABLE A-5. (Continued)

U. T. S., KSI (MN/m ²)	YS. 0.2% OFFSET KSI (MN/m ²)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUKULATIVE PORE VOLUME INCHES ³ (cc)	ACCUMULATIVE PORE AREA INCHES ² (cm ²)	CROSS— SECTIONAL PERCENT PORE AREA
44.48 (305.68)	33.84 (233.22)	2.5	0.0393 (0.0998)	22	0.8636 (2.194)	0.000854 (0.0139946)	0.02939 (0.1896)	6.009
47 76 (329.30)	32.98	3.7	0.05 (0.127)	-	0.05 (0.127)	0.00008213 (0.0013459	0.00217 (0.014)	0.443
1	38 38	3.5	0.05 (0.127)	*	0.2 (0.508)	0.0003285 (0.0053832)	0.00869 (0.0561)	1.779
1 -	33.62	3.0	0.05 (0.127)	7	0.35 (0.889)	0.0005749 (0.0094209)	0.0152 (0.0981)	3.114
1	33.74	2.5	0.05 (0.127)	0 t	0.5 (1.27)	0.0008213 (0.0134587)	0.02172 (0.1401)	4.427
	33.03	2.5	0.05 (0.127)	14	0.7 (1.778)	0.00115 (0.0188451)	0.03041 (0.1962)	6.159
	33.57	2.5	0.05 (0.127)	82	1.0 (2.54)	0.001626 (0.0266454)	0.04344 (0:2803)	8.847
ı	34.11	33	0.05 (0.127)	ı	0.059 (0.15)	0.0001334 (0.002186)	0.00304 (0.0196)	0.623
Ι.	35.28	2.8	0.059 (0.15)	2	0.118 (0.30)	0.0002668 (0.0043721)	0.00608 (0.0392)	1.244
48.03 (331.16)	34.24	3.5	0.059 (0.15)	3	0.117 (0.45)	0.0054002 (0.0065581)	0.00912 (0.0588)	1.877
	33.44	3,0	0.059 (0.15)	•	0.236 (0.599)	0.0005336 (0.0087441)	0.01216 (0.0785)	2.5
(96'90£) 18'77	34.02 (234.56)	2.5	0.059 (0.15)	5	C.295 (0.749)	0.000667 (0.0109302)	0.0152 (0:0981)	3.124
46.56 (314.06)	35.88 (247.39)	2.8	0.059 (0.15)	9	0.354 (0.899)		0.01823 (0.1176)	3.724
	34.91 (240.70)	2.8	0.059 (0.15)	7	0.413 (1.049)	0.0009338 (0.0153022)	0.02127 (0.1372)	4.349
45.27 (312.13)	35.84 (247.11)	3.0	0.059 (0.15)	8	0.472 (1.199)	0.001067 (0.017485)		4.962
46.54 (313.99)	36.61 (252.42)	2.8	0.059 (0.15)	10	0.59 (1.499)	0,001334 (0.0218603)	0.03039 (0.1961)	6.242
44.80 (308.89)	35.03 (248.42)	2.8	0.059 (0.15)	12	0.708 (1.798)	0.001601 (0.0262357)	0.03647 (0.2353)	7.432
44.39 (306.06)		2.8	0.059 (0.15)	14	0.826 (2.098)		0.04255 (0.2745)	8.667
46.62 (314.54)	_	2.8	0.059 :0.15)	16	0.944 (2.398)	- 1	0.04862 (0.3137)	9.982
46.66 (335.50)		3.2	0.07 (0.178)	1	0.07 (0.178)	0.0002336 (0.003828)	0.00437 (0.0282)	0.902
		2.8	0.07 (0.178)	2	0.14 (0.356)	0.0004672 (0.007656)	0.00873 (0.0563)	1.794
45.34 (312.61)		32	0.07 (0.178)	3	0.21 (0.533)	0.0007008 (0.011484)	0.0131 (0.0845)	2.7
	I	2.5	0.07 (0.178)	*	0.28 (0.711)	0.0009344 (0.015312)	0.01747 (0.1127)	3.599
	ı	2.5	0.07 (0.178)	5	0.35 (0.889)	- 1		4.499
	-	2.8	0.07 (0.178)	9	0.42 (1.067)	-	0.0262 (0.169)	5.398
- 1	34.88	22	0.07 (0.178)	7	0.49 (1.245)	- 1	0.03127 (0.2017)	6.440
	35.47	23	0.07 (0.178)	9	0.7 (1.778)		0.04367 (0.2817)	8.934
	_	2.0	0.07 (0.178)	12	0.84 (2.134)	0.002804 (0.0459493)	0.0524 (0.3381)	12 200
(10/21)	+	23	0.07 (0.178)	*	0.98 (2.49)	(1/25250.0) /2c00.0	0.0057 (0.0050)	1 173
4/36 (34/./0)	35.30 (234.08)	3.8	0.0000 0.204		0.000 (0.000)	6	0.000 (0.000)	2 210
AC 76 (217.16)	+	200	0.0000 10.204)	-	0.101 (0.403)	1	0.0171 (0.1103)	3 607
	1	23	0.0805 (0.204)	2	0.222 (0.818)		0.0228 (0.1471)	4.673
	1	23	0.0805 (0.204)	5	0.403 (1.024)	51	0.0285 (0.1839)	5.825
	₩	22	0.0805 (0.204)	9	0.483 (1.227)	0.00211 (0.0345767)	0.0342 (0.2206)	7.004
44.06 (303.78)	_	2.3	0.0805 (0.204)	æ	0.644 (1.636)	0.0028 (0.0458838)	0.0456 (0.2942)	9.36
	I	2.0	0.0805 (0.204)	10		+	0.057 (0.3677)	11.7
42.61 (293.79)	34.24 (236.08)	22	0.0805 (0.204)	12	0.966 (2.454)	0.00422 (0.0691534)	0.0684 (0.4413)	14.016

N. C. MAN/M. CAGE INCHES CAGE INCHES CAGE INCHES CAGE INCHES CAGE INCHES CAGE C		Y.S., 0.2% OFFSET	IN 2 INCH (5.08 cm)	PORE DIAMETER	#	ACCUMULATIVE PORE LINEAR	ACCUMULATIVE PORE VOLUME	ACCUMULATIVE PORE AREA	SECTIONAL PERCENT PORE
86.31 (243,46) 3.2 0.008 (0.244) 1 0.008 (0.224) 0.00000 (0.01952) 0.00000 (0.01952) 0.00000 (0.01952) 0.00000 (0.01952) 0.00000 (0.01952) 0.00000 (0.01952) 0.00135 (0.01977) 0.00135 (0.01977) 0.00135 (0.01977) 0.00135 (0.01977) 0.00135 (0.01977) 0.00135 (0.01977) 0.00135 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01977) 0.00137 (0.01978) 0.00137 (0.01978) 0.00137 (0.01978) 0.00137 (0.01978) 0.00137 (0.01978) 0.00137 (0.01978) 0.00137 (0.01978) 0.00137 (0.01978) 0.00137 (0.01978) 0.00137 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978) 0.00138 (0.01978)	KŞ	(MN/m²)	GAGE LENGTH, PERCENT	INCHES (cm)	PORES.				AREA
2.79 (1755.08) 2.8 0.068 (0.224) 2 0.176 (0.447) 0.0001356 (0.0319781) 0.0001356 (0.0319781) 0.000358 (0.0234) 3 0.0244 (0.647) 0.0001356 (0.0219781) 0.0001358 (0.0219781) 0.000358 (0.0234) 4 0.0224 (0.0271) 0.0001356 (0.0219781) 0.0001358 (0.0219781) 0.000358 (0.0234) 4 0.02258 (0.0219781) 0.0001358 (0.0219781) 0.0001358 (0.0219781) 0.0000358 (0.0234) 6 0.044 (1.1198) 0.0001358 (0.0231781) 0.0001358 (0.0231781) 0.0000358 (0.0231781) 0.0000358 (0.0231781) 0.0000358 (0.0231781) 0.0000358 (0.0231781) 0.0000358 (0.0231781) 0.0000358 (0.0231781) 0.0000373 (0.0003582) 0.0000358 (0.02317821)	ĺ		3.3	0.0FB (0.224)	-	0.088 (0.224)	0.000445 (0.0072922)	0.00678 (0.0437)	1.391
2.2.86 (1276-17) 3.5 0.086 (0.224) 4 0.264 (0.671) 0.003228 (0.0291) 0.00772 (0.029169) 0.00772 (0.029169) 0.00772 (0.022278) 0.007228 (0.02916) 0.00772 (0.022278) 0.00772 (0.022278) 0.00772 (0.022278) 0.00772 (0.022278) 0.00772 (0.022278) 0.00772 (0.022278) 0.00772 (0.022278) 0.00772 (0.022278) 0.00722 (0.02227	3 8	-	28	0.068 (0.224)	2	0.176 (0.447)	0.00089 (0.0145845)	0.01356 (0.0875)	2.771
4.3.7.2 (1726.17) 2.5 0.088 (0.224) 6 0.382 (0.894) 0.0007225 (0.03256) 0.00081 34.3.7 (1226.37) 2.3 0.088 (0.224) 6 0.024 (1.178) 0.000227 (0.042753) 0.00081 34.3.7 (1226.37) 2.3 0.088 (0.224) 6 0.024 (1.1784) 0.000227 (0.042753) 0.00671 35.1.4 (1226.48) 2.3 0.088 (0.224) 8 0.034 (1.1784) 0.000227 (0.042733) 0.006731 35.2.0 (1224.08) 3.2 0.088 (0.221) 1 0.026 (1.224) 0.00744 (1.1784) 0.007473 0.00753 35.2.0 (1234.08) 3.2 0.089 (0.251) 3 0.028 (0.251) 3 0.028 (0.251) 0.0084 (1.1784) 0.00753		1		0.088 (0.224)	e.	0.264 (0.671)	0.001335 (0.0218767)	0.02034 (0.1312)	4.168
3.4.0 (225.1) 2.3 (0.086 (0.224) 6 (0.044 11.18) 0.002226 (0.0354612) 0.0441 0.	-	- 1		0.009 (0.224)	•	0.352 (0.894)	0.00178 (0.029169)	0.02712 (0.175)	5.543
34.30 (227.18) 2.3 0.088 (0.224) 6 0.528 (1.34) 0.00545 (0.043753) 0.0065 (0.0223) 0.0065 (0.224) 0.0068 (0.224) 0.0068 (0.224) 0.0068 (0.224) 0.0068 (0.224) 0.0068 (0.224) 0.0068 (0.0223) 0.0068 (0.0233) 0.0068 (0.02	~	1		0.000 (0.224)	ء	0.44 (1.118)	0.002225 (0.0364612)	0.03391 (0.2188)	6.938
31.14 1272.45 1.3 1.0	-	- -	2.5	0 000 (0.224)		0.528 (1,341)	0.00267 (0.0437535)	0.04061 (0.2620)	8.366
3.0.00 (2.24.42) 3.2 0.000 (0.25) 1 0.000 (0.25) 0.0000000 0.017330 0.0000000 0.017330 0.0000000 0.017330 0.0000000 0.017330 0.0000000 0.017330 0.00000000 0.017330 0.0000000 0.017330 0.0000000 0.017330 0.0000000 0.017330 0.00000000 0.017330 0.00000000 0.017330 0.00000000 0.017330 0.0000000 0.017330 0.0000000 0.017330 0.0000000 0.017320 0.0000000 0.017320 0.00000000 0.017320 0.0000000 0.0000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.0000	+	-1-	23	0.000 (0.224)	3	0.704 (1.788)	0.00356 (0.0583379)	0.05425 (0.3500)	11.073
3.00 12.5. 1.00	-	-1-		0.000 (0.224)	9	0.88 (2.235)	0.00445 (0.0729224)	0.06781 (0.4375)	13.859
3.3.56 1276.340 2.3 0.0999 0.2511 3 0.2994 0.02512 0.0015280	+	71		0.000 (0.251)	-	0.099 (0.251)	0.0006443 (0.0105582)	0.00866 (0.0559)	1.767
3.7.7. (2.26.27) 3.2. 0.0299 (0.251) 3.2. 0.0299 (0.251) 4.0.001952 (0.021981) 0.002578 (0.0222981) 0.002668 (0.022228) 0.002698 (0.022298) 0.002698 (0.022228) 0.002698 (0.022298) 0.002698 (0.022228) 0.002698 (0.022298) 0.002698 (0.02228) 0.002698 (0.022289) 0.002698 (0.022389) 0.002698 (0.022389) 0.002698 (0.022389) 0.002698 (0.022389) 0.002698 (0.022389) 0.002698 (0.022389) 0.002698 (0.022389) 0.002238 (0.022389)	+	- 1 -	2.5	0.030 (0.251)	2	0.198 (0.503)	0.001289 (0.0211229)	0.01733 (0.1118)	3.53
32.46 120.25 2.3 0.0099 0.25 4 0.396 1.006 0.0025/8 0.0042459) 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.003322 0.00332	-	- 1	3.2	0,000 (0,051)	•	0.287 (0.754)	0.001933 (0.0316762)	0.02599 (0.1677)	5.31
3.4. 27 (1226.24) 2.5 0.0999 (0.251) 5 0.466 (1.257) 0.002322 (0.0627991) 0.04332 (0.0623824) 0.04332 (0.0623824) 0.04332 (0.0623824) 0.04332 (0.0623824) 0.04332 (0.0623824) 0.0699 (0.251) 6 0.584 (1.509) 0.005443 (0.0623824) 0.0653 (0.0623824) 0.0663 (0.0623824) 0.0663 (0.0623824) 0.0663 (0.0623824) 0.0663 (0.0623824) 0.005442 (0.06248) 0.0663 (0.0623824) 0.005442 (0.06248)	-	- 1	3.5	0,000 (0,000)	•	0.396 (1.006)	0.002578 (0.0422459)	0.03465 (0.2235)	7.111
3.2.56 (220.70) 1.2.9 (0.000) 0.0000 (0.251) 6 0.546 (1.500) 0.0005166 (0.000448) 77 0.0005166 (0.000448) 77 0.0005166 (0.000448) 77 0.0005166 (0.000448) 77 0.0005166 (0.000448) 77 0.0005166 (0.000448) 77 0.0005166 (0.000448) 77 0.0005166 (0.000448) 77 0.0005166 (0.000448) 77 0.0005463 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000478) 0.000563 (0.000578) 0.000563 (0.000578) 0.000563 (0.000578) 0.000563 (0.000578) 0.000563 (0.000574) 0.000563 (0.000574) 0.000563 (0.000574) 0.000563 (0.000574) 0.000563 (0.000574) 0.000563 (0.000574) 0.000563 (0.000574) 0.000563 (0.000574) 0.000563 (0.000574) 0.000563 (0.000574) 0.000563 (0.000574) 0.000576 (0.000574) 0.000576 (0.000574) 0.000576 (0.000574) 0.000576 (0.000574) 0.0005774 (0.0005744) 0.0005774 (0.0005744) 0.0005774 (0.000574) <td>-+</td> <td>- 1</td> <td></td> <td>0.000</td> <td>•</td> <td>0.405 (1.257)</td> <td>0.003222 (0.0527991)</td> <td>0.04332 (0.2795)</td> <td>8.816</td>	-+	- 1		0.000	•	0.405 (1.257)	0.003222 (0.0527991)	0.04332 (0.2795)	8.816
33.8 1286.84 1.7 0.0999 0.251 8 0.792 12.012 0.005156 0.006443 0.1055619 0.00663 0.00693 0.201043 0.2029 12.012 0.109 0.271 1 0.109 0.277 0.006443 0.1055619 0.006633 0.0066443 0.1055619 0.006633 0.0066443 0.105 0.277 1 0.109 0.277 0.006968 0.001736 0.001732 0.006968 0.00474 0.0071736	-	- 1		10.00 U.S.	0	0 504 (1 500)	O 003868 (0.0633524)	0.05.198 (0.3354)	10.66
32.90 (276.84) 2.3 0.098 (0.251) 10 0.024 (2.51) 0.00643 (0.274) 0.00643 (0.277) 0.006 (0	-	- 1		0.039 (0.251)	9	100 C) COL O	0.005156 (0.0844917)	0.0693 (0.4471)	14.161
33.78 (232.91) 1.B 0.0098 (0.231) 1.D 0.026 (2.271) 0.000988 (0.014224) 0.01094 (0.2724) 0.0109 (0.277) 1.000 (0.277) 2 0.218 (0.2554) 0.000988 (0.014224) 0.02697 (0.02697) 0.02687 (0.02697) 0.0277 (0.6331) 0.0277 (0.6331) 0.02687 (0.02697) 0.02687 (0.02697) 0.0277 (0.6331) 0.000264 (0.042679) 0.02687 (0.02697) 0.0277 (0.02697) 0.0277 (0.02697) 0.0277 (0.02697) 0.0277 (0.02697) 0.0277 (0.02697) 0.0277 (0.02697) 0.0277 (0.02697) 0.0277 (0.02697) 0.0277 (0.02697) 0.0277 (0.02697	-	- 1	 -	0.089 (0.25)	2	0.00 (2.51)	0 006443 (0.1055819)	0.08663 (0.5589)	17.734
32.84 (226.43) 2.5 0.109 (0.277) 2 0.218 (0.654) 0.001736 (0.028479) 0.02067 (0.02087) 32.06 (227.15) 2.5 0.109 (0.277) 2 0.218 (0.631) 0.0001736 (0.028479) 0.001736 (0.028479) 31.46 (227.15) 2.5 0.109 (0.277) 4 0.436 (1.107) 0.0003472 (0.058959) 0.04174 (1.0512) 33.46 (220.15) 2.0 0.109 (0.277) 6 0.664 (1.661) 0.0003472 (0.058959) 0.04174 (1.0612) 33.46 (220.15) 2.0 0.109 (0.277) 6 0.667 (1.661) 0.000347 (1.0612) 0.0003	-	7		10.00	₽,	0 400 (0 277)	0 000888 (0.014224)	0.01043 (0.0673)	2.155
32 06 (221.15) 2.5 0.109 (0.277) 2 0.426 (1.107) 0.002604 (0.0428719) 0.0313 (0.04174 (0.0438719)) 32.06 (221.05) 2.5 0.109 (0.277) 4 0.436 (1.107) 0.005208 (0.056959) 0.04174 (0.056973) 33.06 (221.05) 2.0 0.109 (0.277) 6 0.664 (1.067) 0.005208 (0.056969) 0.04174 (0.05277) 33.09 (222.15) 2.0 0.1206 (0.277) 6 0.672 (2.215) 0.005340 (0.053697) 0.055347 (0.05594) 32.09 (222.15) 2.5 0.1206 (0.206) 7 0.1206 (0.206) 7 0.05746 (0.05594) 0.05746 (0.0574298) 0.05774 (0.0574298) 32.5 (224.26) 1.8 0.1206 (0.306) 4 0.482 (1.224) 0.005346 (0.0574298) 0.05774 (0.0574298) 32.5 (225.24) 1.8 0.1206 (0.306) 4 0.482 (1.224) 0.004346 (0.0574297) 0.050548 (0.0574298) 32.6 (226.26) 2.2 0.1206 (0.306) 6 0.722 (1.236) 0.00434 (0.0574294) 0.00434 (0.0574294) 32.4 (226.28) 2.5 0.1206 (0.306) 6 0.224 (0.674394) 0.00	-			0.109 (0.277)	- (0.109 (0.277)	0.001736 (0.0284479)	0.02087 (0.1346)	4.296
32.06 (221.05) 25 0.109 (0.277) 4 0.445 (1.697) 0.003472 (0.048999) 0.04174 (0.048999) 0.04174 (0.048999) 0.04174 (0.048999) 0.04174 (0.048999) 0.04174 (0.048999) 0.04174 (0.048999) 0.04174 (0.048999) 0.04174 (0.048999) 0.04174 (0.048999) 0.04174 (0.048999) 0.0620 (0.04277) 4 0.452 (2.218) 0.06530 (0.048999) 0.05274 (0.048999) 0.05274 (0.048999) 0.05274 (0.048999) 0.05274 (0.048999) 0.05274 (0.048999) 0.052774	-	- 1		0.109 (0.277)	,	0.201 (0.201)	0.002604 (0.0426719)	0.0313 (0.2019)	6.446
31.46 (276.91) 2.2 0.109 (0.277) 6 0.654 (1.661) 0.005206 (0.083438) 0.005206 (0.083438) 0.005206 (0.083438) 0.005206 (0.083438) 0.005201 (0.137918) 0.005201 (0.137918) 0.005201 (0.137918) 0.005201 (0.137918) 0.005201 (0.137918) 0.005201 (0.137918) 0.005201 (0.137918) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.137616) 0.005201 (0.1487945) 0.005201 (0.1487	-	- 1		0.108 10.277		0.426 (1.107)	0.003472 (0.0568959)	0.04174 (0.2695)	8.538
33.38 (230.15) 2.0 0.109 (0.277) 8 0.577 (1.215) 0.0668440 (0.1137918) 0.06247 (0.113918) 0.06247 (0.1126) 32.57 (224.56) 2.7 0.109 (0.277) 6 0.1206 (0.306) 0.1206 (0.306) 0.0705 (0.306) 0.0705 (0.306) 0.0705 (0.306) 0.0705 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.306) 0.0205 (0.236) 0.0005 (0.006)	-			0.109 (0.2///		0.654 (1.661)	0.005208 (0.083438)	0.0626 (0.4039)	12.782
32.57 (224.56) 2.7 (0.105 10.277) 4.005 10.275 (0.205) 4.005 10.275 (0.205) 0.00135 (0.205) 0.00125 (0.205) 0.00125 (0.205) 0.00125 (0.205) 0.00125 (0.205) 0.00227 (0.002786) 0.0025 (0.205)	-	- 1		0.109 (0.2//)	> #	12001 (2000	0.0069440 (0.1137918)	0.08347 (0.5385)	17.126
33.129 (228.15) 2.5 0.1205 (0.305) 2 0.241 (0.512) 0.00227 (0.037286) 0.02516 (0.3744) 33.2 (228.26) 2.0 0.1205 (0.306) 3 0.241 (0.512) 0.003405 (0.055798) 0.03774 (0.3774) 32.5 (228.28) 2.0 0.1205 (0.306) 4 0.482 (1.224) 0.00454 (0.0743673) 0.05032 (0.3748) 32.8 (228.28) 2.0 0.1205 (0.306) 6 0.732 (1.224) 0.00568 (0.115945) 0.00568 (0.11596) 0.00568 (0.11596) 0.00568 (0.0146) 0.00568 (0.11596) 0.00568 (0.11596) 0.00568 (0.11596) <td< td=""><td>-</td><td>- 1</td><td></td><td>0.105 (0.207)</td><td>,</td><td>0 120E (0 20E)</td><td>0.001135 (0.0185993)</td><td>0.01258 (0.0812)</td><td>2.567</td></td<>	-	- 1		0.105 (0.207)	,	0 120E (0 20E)	0.001135 (0.0185993)	0.01258 (0.0812)	2.567
33.12 (228.36) 2.0 0.1200 (0.306) 3 0.3615 (0.316) 0.005406 (0.055798) 0.005774 (0.0743673) 0.005774 (0.0743673) 32.53 (224.29) 1.8 0.1206 (0.306) 4 0.462 (1.224) 0.00664 (0.0743673) 0.00502 (0.0052) 32.56 (226.84) 3.0 0.1206 (0.306) 6 0.724 (1.224) 0.00681 (0.115959) 0.00548 (0.0052) 32.6 (226.84) 2.5 0.1206 (0.306) 8 0.364 (2.449) 0.00688 (0.148745) 0.0064 (0.0064) 33.42 (226.84) 2.7 0.132 (0.336) 2 0.264 (0.671) 0.0098 (0.148745) 0.01492 (0.0064) 33.42 (226.36) 2.3 0.132 (0.336) 2 0.264 (0.671) 0.00292 (0.0478652) 0.00476 (0.02924) 32.4 (226.36) 2.3 0.132 (0.336) 4 0.526 (1.240) 0.00584 (0.0077753) 0.00476 (0.00764) 32.4 (226.26) 2.3 0.132 (0.336) 4 0.526 (1.240) 0.00584 (0.0077753) 0.00476 (0.00764) 32.5 (226.26) 2.3 0.132 (0.336) 4 0.526 (1.240) 0.00576 (0.00576) 0.00576 (0.00576) <td></td> <td>· 1</td> <td></td> <td>0.1200 10.300</td> <td></td> <td>0.144 (0.642)</td> <td>0.00227 (0.0372986)</td> <td>0.02516 (0.1623)</td> <td>5.096</td>		· 1		0.1200 10.300		0.144 (0.642)	0.00227 (0.0372986)	0.02516 (0.1623)	5.096
32 53 (224.28) 18 0.155 (0.306) 4 0.482 (1.24) 0.00454 (0.0743973) 0.00502 (0.07548) 32 19 (226.54) 2.2 0.1205 (0.306) 6 0.723 (1.424) 0.00681 (0.115958) 0.07548 (0.07548) 32 19 (226.32) 2.5 0.1205 (0.306) 8 0.464 (2.449) 0.00681 (0.115954) 0.1064 (0.07548) 32 42 (226.32) 2.7 0.132 (0.336) 2 0.264 (0.671) 0.00592 (0.0478502) 0.01492 (0.0064) 33 42 (226.36) 2.7 0.132 (0.336) 2 0.264 (0.671) 0.00292 (0.0478502) 0.01492 (0.0064) 33 42 (226.36) 2.3 0.132 (0.336) 4 0.264 (0.671) 0.00292 (0.0478502) 0.0492 (0.0478502) 33 42 (226.36) 2.3 0.132 (0.336) 4 0.524 (1.671) 0.00292 (0.0478502) 0.04964 (0.0677753) 32 44 (226.36) 2.3 0.132 (0.336) 4 0.524 (1.041) 0.00584 (0.0677753) 0.04962 (0.0584) 32 50 (224.08) 2.3 0.132 (0.336) 6 0.782 (2.012) 0.00676 (0.1455607) 0.00662 (0.06676) 3				0.1202 (0.306)		0.2616 (0.018)	0.003405 (0.055798)	0.03774 (0.2435)	7.638
3.19 (278 84) 2.7 0.0681 (0.115958) 0.07548 (0.115958) 0.07548 (0.115958) 0.07548 (0.115958) 0.07548 (0.115958) 0.07548 (0.115958) 0.07548 (0.115958) 0.07548 (0.115958) 0.07548 (0.115958) 0.07548 (0.115958) 0.07548 (0.115958) 0.01492 (0.10548) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.01492 (0.1467945) 0.0144792 (0.1467944)	_			0.14.5 (0.300)		0.482 (1.224)	0.00454 (0.0743973)	0.06032 (0.3246)	10.248
3.3.15 (2.0.24) 3.0 0.1467945) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.3064) 0.10064 (0.0064) <td>-</td> <td>- 1</td> <td></td> <td>0.1200 10.300</td> <td></td> <td>0 773 (1 836)</td> <td>0.00681 (0.1115858)</td> <td>0.07548 (0.4870)</td> <td>15.47</td>	-	- 1		0.1200 10.300		0 773 (1 836)	0.00681 (0.1115858)	0.07548 (0.4870)	15.47
32 (25.32) 2.5 0.1 (20.00) 0.0 (1.32) <td>-</td> <td>- 1</td> <td></td> <td>0.1200 (0.300)</td> <td></td> <td>0.054 (2.449)</td> <td>0.00908 (0.1487945)</td> <td>0.10064 (0.6493)</td> <td>20.518</td>	-	- 1		0.1200 (0.300)		0.054 (2.449)	0.00908 (0.1487945)	0.10064 (0.6493)	20.518
33.48 (2.30.24) 2.7 0.132 (0.335) 2 0.264 (0.671) 0.00292 (0.0478502) 0.0294 (0.02920) 33.48 (2.30.24) 2.7 0.132 (0.335) 2 0.264 (0.671) 0.00438 (0.0717753) 0.04476 (0.0476) 33.12 (2.20.36) 2.3 0.132 (0.335) 4 0.528 (1.041) 0.00584 (0.0957005) 0.04476 (0.0957005) 0.04476 (0.0957005) 0.04568 (0.0957005) 0.04476 (0.0957005) 0.04568 (0.0957005) 0.04568 (0.0957005) 0.04568 (0.0957005) 0.09682 (0.09676) 0.04568 (0.0957005) 0.09682 (0.09676) 0.04568 (0.0957005) 0.04568 (0.0957005) 0.04568 (0.0957005) 0.04568 (0.0957005) 0.01736 (0.09676) 0.01736 (0.09676) 0.01736 (0.09676) 0.01736 (0.0509952) 0.01736 (0.0509952) 0.01736 (0.0509952) 0.00452 (0.0509952) 0.05178 (0.05098 (0.091463) 0.05178 (0.05098 (0.091463) 0.05178 (0.05098 (0.091463) 0.05178 (0.05098 (0.0504463) 0.05178 (0.05098 (0.0504463) 0.05178 (0.05098 (0.0504463) 0.05178 (0.05098 (0.0504463) 0.05178 (0.05098 (0.0504463) 0.05178 (0.05098 (0.0504463) 0.05178 (0.05098 (0.0504463) 0.05178 (0.05098 (0.0504463) 0.05178 (0.0504463) 0.05178 (0.0504463) 0.0517	-	-1		0.1200 (0.300)	•	0 120 10 3351	0.00146 (0.0239251)	0.01492 (0.0963)	3.049
33.48 (230.84) 2.7 0.132 (0.35) 2 0.245 (1.096) 0.00438 (0.0717753) 0.04476 (0.065706) 33.12 (226.36) 2.3 0.132 (0.356) 4 0.528 (1.341) 0.00584 (0.065706) 0.06982 (0.06582) 33.33 (229.80) 2.3 0.132 (0.356) 6 0.792 (2.012) 0.00676 (0.143507) 0.09982 (0.09982 (0.095706) 33.33 (229.80) 2.0 0.132 (0.356) 8 1.066 (2.682) 0.01198 (0.1814C; 0.011936 (0.1914C; 33.50 (234.20) 2.8 0.1415 (0.359) 1 0.1415 (0.359) 0.01415 (0.359) 0.001445 (0.19142) 33.52 (231.11) 2.0 0.1415 (0.359) 3 0.4245 (1.078) 0.006583 (0.05142) 0.05178 33.52 (231.11) 2.0 0.1415 (0.359) 3 0.4245 (1.078) 0.006583 (0.05142) 0.05178	-	-1		0.132 10.330	,	0 364 (0 671)	0.00292 (0.0478502)	0.02984 (0.1925)	6.1
33.12 (278.36) 2.3 0.132 (0.335) 4 0.628 (1.341) 0.00564 (0.0857005) 0.0898 (0.0857005) 0.0898 (0.08574) 32.74 (278.374) 1.8 0.132 (0.335) 6 0.792 (2.012) 0.00676 (0.1435907) 0.08952 (0.08952 (0.085807) 0.08952 (-	- 1		0.132 (0.335)	4	1900 (1 000)	0.00438 (0.0717753)	0.04476 (0.2888)	9.127
32.74 (225.74) 1.8 0.132 (0.335) 4 0.132 (1.31) 0.00676 (0.1435507) 0.09952 (0.1326) 33.33 (229.80) 2.3 0.132 (0.335) 6 0.792 (2.012) 0.00676 (0.143507) 0.01936 (0.143507) 33.36 (234.29) 2.0 0.1415 (0.335) 1 0.1415 (0.359) 0.01415 (0.359) 0.01726 33.11 (226.29) 2.2 0.1415 (0.359) 3 0.4245 (1.778) 0.006593 (0.051429) 0.00452 33.52 (231.11) 2.0 0.1415 (0.359) 3 0.4245 (1.778) 0.006593 (0.051429) 0.005178	-	- 1		0.132 (0.330)	1	Verse 11 244)	0.00584 (0.0957005)	0.05968 (0.385)	12.17
33 33 (229.80) 2.3 0.132 (0.335) 8 0.435 (229.82) 0.01108 (0.19:4C; 0.11936 (3.325) 32 50 (224.08) 2.0 0.132 (0.335) 8 1.066 (2.359) 0.01186 (0.359) 0.01726 33 56 (234.29) 2.8 0.1415 (0.359) 1 0.1415 (0.359) 0.01415 (0.359) 0.00145 33 52 (231.11) 2.0 0.1415 (0.359) 3 0.4245 (1.078) 0.006583 (0.054423) 0.05178	-	ı		0.132 (0.38)	,	1000 11000	0.00876 (0.1435507)	0.08952 (0.5775)	18.314
32.50 (224.08) 2.0 0.132 (0.359) 8 1.000 (2.362) 0.0136 (0.304562) 0.01726 33.96 (234.29) 2.8 0.1415 (0.359) 1 0.1415 (0.359) 2 0.0283 (0.719) 0.0004527 0.03452 33.11 (226.29) 2.0 0.1415 (0.359) 3 0.4245 (0.778) 0.000583 (0.061423) 0.05178 33.52 (231.11) 2.0 0.1415 (0.359) 3 0.4245 (1.778) 0.000583 (0.061423) 0.05178		- 1		0.132 (0.335)	9	19,000 13 6001	0.0000000000000000000000000000000000000	0.11936 (0.7701)	24.524
33.96 (234.29) 2.8 0.1415 (0.359) 1 0.1415 (0.359) 2 0.2452 0.00452 33.11 (226.29) 2.0 0.1415 (0.359) 3 0.4245 (10.78) 0.006583 (0.06142) 0.05178 33.52 (231.11) 2.0 0.1415 (0.359) 3 0.62445 (10.78) 0.006583 (0.06142) 0.05178		- 1		0.132 (0.336)		1,000,01,000,1	A SALES IN MODILES.		3.537
33.11 (228.29) 2.2 0.1415 (0.359) 2 0.283 (0.719) 0.005583 (0.091429) 0.05178 3 0.2845 (1.778) 0.005583 (0.091429) 0.05178 3 0.2845 (1.778) 0.005583 (0.091429) 0.05178		- 1		0.1415 (0.359)	-	(80°-0) CI \$1.0	0.00100 0.000000		7.021
33.52 (231.11) 2.0 0.1415 (0.309) 3 0.4240 (1.009) (0.000000) (0.000000)	_	Ħ		0.1415 (0.359)	2	0.283 (0.719)	0.003/22 (0.000992)	1	10.604
	_	- 1		0.1415 (0.309)	8	10/0/11 0/00	0.002444 M 1210053	1	14.297

ORIGINAL PAGE IN

43

TABLE A-5. (Concluded)

CROSS— SECTIONAL PERCENT PORE AREA	21.3	28.394	3.821	7.594	11.45	15.257	22.943	4.572	9.132	13.723	18.297	27.474	5.223	10.441	15.596	21.176	31.659	6.155	12.245	18.36	24.742	37.196	6.435	12.889	19.322	7.231	14.408	73.03/					
ACCUMULATIVE PORE AREA INCHES ² (cm ²)	0.10356 (0.6681)	0.13808 (0.8908)	0.01853 (0.1195)	0.03706 (0.2391)	0.05559 (0.3586)	0.07412 (0.4782)	0.11118 (0.7173)	0.0223 (0.1439)	0.0446 (0.2877)	0.0669 (0.4316)	0.0892 (0.5755)	0.1338 (0.8632)	0.02567 (0.1656)	0,05134 (0,3312)	0.07701 (0.4968)	0.10268 (0.6625)	0,15402 (0,9837)	0.03016 (0.1946)	0.06032 (0.3892)	0.09048 (0.5837)	0,12064 (0,7783)	0.18096 (1.1675)	0.03136 (0.2023)	0.06272(0.4046)	0.09408 (0.607)	0.03536 (0.2281)	0.07072 (0.4563)	0.14144 (0.9125)					
ACCUMULATIVE PORE VOLUME INCHES ³ (æ)	0.01117 (0.1830435)	0.01489 (0.2440034)	0.002045 (0.0335115)	0.00409 (0.0670231)	0.006135 (0.1005346)	0.00818 (0.13404618)	0.01227 (0.2010693)	0.0027 (0.0442451)	0.0054 (0.0884901)	0.0081 (0.1327352)	0.0108 (0.1769803)	0.0162 (0.2654704)	0.003346 (0.0548311)	0.006692 (0.1096622)	0.01004 (0.1645261)	0.01338 (0.2192589)	0.02008 (0.3290522)	0.004193 (0.068711)	0.008386 (0.1374219)	0.01258 (0.2061493)	0.01677 (0.2748111)	0.02516 (0.4122985)	0.004499 (0.0737254)	0.008998 (0.147451)	0.01349 (0.221061)	0.005471 (0.089654)	0.01094 (0.179274)	0.02188 (0.358549)			ESULTS.		
ACCUMULATIVE PORE LINEAR INCHES (cm)	0.849 (2.156)	1,132 (2,875)	0.1485 (0.377)	0.297 (0.754)	0.4455 (1,132)	0.594 (1.509)	0.891 (2.263)	0.1605 (0.408)	0.3205 (0.814)	0.4815 (1.223)	0.642 (1.631)	0,963 (2,446)	0.171 (0.434)	0.342 (0.869)	0,513 (1,303)	0.684 (1.737)	1.026 (2.606)	0.1845 (0.469)	0.369 (0.937)	0.5535 (1.406)	0.738 (1.875)	1.107 (2.812)	0.191 (0.485)	0.382 (0.97)	0.573 (1.456)	0.2025 (0.514)	0.405 (1.029)	0.81 (2.057)			OR MORE TEST RE		
NUMBER OF PORES	6	æ	1	2	3	4	9	1	2	3	4	9	•	2	3	4	9	1	2	. 3	7	9	-	2	3	-	2	•		WCH WIDE.	E OF THRE		
PORE DIAMETER INCHES (cm)	0.14% (0.359)	0.1415 (0.359)	0.1485 (0.377)	0.1485 (0.377)	0.1485 (0.377)	0.1485 (0.377)	0.1485 (0.377)	0.1605 (0.408)	0.1605 (0.408)	0.1605 (0.408)	0.1605 (0.408)	0.1605 (0.408)	0.171 (0.434)	0.171 (0.434)	0.171 (0.434)	0.171 (0.434)	0.171 (0.434)	0.1845 (0.469)	0.1845 (0.469)	0.1845 (0.469)	0.1845 (0.469)	0.1845 (0.469)	0.191 (0.485)	0,191 (0.485)	0.191 (0.485)	0.2025 (0.514)	0.2025 (0.514)	0.2025 (0.514)		TENSILE SPECIMENS WERE ONE			
ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	2.5	1.8	3.8	25	20	22	22	22	1.7	22	2.5	22	2.8	2.8	2.0	2.0	2.0	2.7	2.2	2.0	3.0	11	2.7	2.2	2.0	2.8	22	1.88		TENSILE SPECIM	H VALUE SHOW		
Y.S., 0.2% OFFSET KSI (MN/m ²)	33.03 (227.74)	32.27 (222.08)	33.24 (229.18)	32 81 (226.22)	31.41 (216.57)	33.45 (230.63)	32.51 (224.75)	33.65 (232.01)	22.45 (223.74)	31,55 (217.53)	31.69 (217.12)	30,37 (209.40)	33.10 (228.22)	32.13 (221.53)	30.90 (213.05)	30.58 (210.84)	(99.902) 26.62	(80.8ZZ) 90°CE	32.01 (220.70)	30.64 (211.26)	36.11 (207.60)	(128.80) (198.57)	32.98 (227.39)	31.53 (217.39)	29.49 (203.33)	32.50 (224.08)	30.31 (208.98)	29.21 (201.40)	MOTES	(1) AL	EAC		
U. T. S., KSI (MN/m ²)	41.34 (285.03)	37.25 (256.83)		41.52 (286.27)	40.11 (276.55)	40.86 (281.72)	38.57 (265.93)	44.61 (307.58)	42.53 (293.24)	40.82 (281.45)	40.72 (260.76)	39.32 (271.10)	`	Г	38.58 (266.00)	45.30 (277.86)	37.33 (257.38)	(58,062) (12,089)	39.30 (270.97)	36.18 (249.45)	38.10 (269.59) ¹	33.39 (230.22)	42.12 (290.41)	39.69 (273.65)	35.17 (242.49)	41.24 (284.34)	36.18 (263.24)	34.40 (237.18)					

TABLE A-6. FLUSH BEAD TENSILE RESULTS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.125 IN. (0.318 CM) SHEET ALUMINUM ALLOY 2219-T87

U. T. S., KSI (MN/m ²)	Y.S., 0.2% OFFSET KSI (MN/m ²)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES ³ (æ)	ACCUMULATIVE PORE AREA INCHES ² (cm ²)	CROSS— SECTIONAL PERCENT PORE AREA
40 10 (276 48)	27.01 (186.23)	2.70	0	0	0	0	0	0
39.04 (269.18)	26.96 (186.02)	2.66	0.0125 (0.0328)	Š	0.0625 (0.1588)	0.00000622 (0.0001019)	0.00069 (0.00445)	0.601
38 68 (265 69)	27.10 (186.85)	2.33	0.0125 (0.0318)	10	0.125 (0.3175)	0.00001244 (0.0002039)	0.00138 (0.00890)	1.205
36.97 (754.90)	26.81 (184.85)	200	3.0125 (0.0318)	15	0.1875 (0.4763)	0,00001866 (0,0003058)	0.00207 (0.01335)	1.840
37.68 (259.80)	27.39 (188.85)	2.00	0.0125 (0.0318)	20	0.25 (0.635)	0.00002488 (0.0004077)	0.00276 (0.01781)	2.400
37.47 (258.34)	27.09 (186.78)	1.83	0.6125 (0.0318)	22	0.3125 (0.7938)	0.000003110 (0.0005096)	0.00345 (0.02226)	2.970
	27.64 (190.58)	1.83	0.0125 (0.0318)	8	0.375 (0.9525)	0.00003732 (0.0006116)	0.00414 (0.02671)	3.600
38.69 (266.76)	28.71 (197.95)	1.83	0.0125 (0.0318)	æ	0.4125 (1.0478)	0.00004105 (0.0006727)	0.00455 (0.02935)	4.030
	25.83 (178.10)	2.83	0.019 (0.0483)	4	0.076 (0.1930)	0.00001629 (0.0002669)	0.00126 (0.00813)	1.163
38.48 (251.52)	26.49 (182.64)	2.50	0.019 (0.0483)	7	0.133 (0.3378)	0.0000285 (0.0004670)	0.00221 (0.01426)	1.885
36.05 (248.55)	26.98 (186.02)	2.50	0.019 (0.0483)	10	0.19 (0.4826)	0.00004072 (0.0006673)	0.00315 (0.02032)	2.751
36.98 (254.97)	26.47 (182.60)	2.33	0 019 (0.0483)	13	0.247 (0.6274)	0.00005294 (0.0008675)	0.00410 (0.02645)	3.611
36.48 (251.52)	27.33 (188.44)	2.00	0.019 (0.0483)	16	0.304 (0.7722)	0,00006515 (0,0010676)	0.00504 (0.03252)	4.326
36.92 (247.66)	26.99 (186.09)	2.00	0.019 (0.0483)	19	0.361 (0.9169)	0.00007737 (0.0012679)	0.00599 (0.03865)	5.282
35.94 (247.80)	26.61 (183.47)	217	0.019 (0.0483)	22	0.418 (1.0617)	0.00008958 (0.0014680)	0.00693 (0.04471)	5.979
37.42 (258,07)	27.65 (190.65)	2.00	0.019 (0.0483)	92	0.475 (1.2065)	0.0001018 (0:0016682)	0.00788 (0.05084)	6.848
36,42 (251.11)	26.54 (182.99)	2.17	0.029 (0.0737)	7	0.116 (0.2946)	0.0000626 (0.0010258)	0.00290 (0.01871)	2.596
36.88 (247.38)	26.36 (181.74)	2.67	0.029 (0.0737)	7	0.203 (0.5156)	0,0001096 (0,0017960)	0.00508 (0.03277)	4.409
36.75 (246.49)	26.39 (181.95)	2.33	0.029 (0.0737)	10	0.29 (0.7366)	0.0001565 (0.0025646)	0.00725 (0.04677)	6.343
36.07 (241.80)	26.42 (182.16)	1.67	0.029 (0.0737)	13	0.377 (0.9576)	0.0002035 (0.0033348)	0.00943 (0.00084)	8.400
34.03 (234.63)	25.88 (178.44)	1.50	0.029 (0.0737)	16	0.464 (1.1786)	0.0002504 (0.0041033)	0. 1160 (0.07484)	10.247
38.52 (272.48)	26.98 (186.02)	2.83	0.0393 (0.0998)	1	0.0393 (0.0998)	0.00003882 (0.0006361)	0.00134 (0.00865)	1.166
38.49 (251.66)	26.53 (182.92)	2.16	(9660'0) 260'0	3	0.1178 (0.2992)	0.0001165 (0.0019091)	0.00401 (0.02587)	3.534
35.35 (243.73)	25.95 (178.92)	2.50	0.0393 (0.0998)	2	0.1963 (0.4986)	0.0001941 (0.0031807)	0.00668 (0.04310)	5.779
34.49 (237.87)	26.57 (183.19)	2.00	0.0393 (0.0998)	7	0.2748 (0.6980)	0.0002717 (0.0044524)	0.00935 (0.06032)	22.
13.47 (230.77)	25.43 (175.33)	1.83	0.0393 (0.0998)	Ó	0.3533 (0.8974)	0.0003494 (0.0057256)	0.01202 (0.07755)	10.483
33.04 (227.81)	25.77 (177.68)	1.67	0.0393 (0.0998)	11	0.4318 (1.0968)	0.000427 (0.0069973)	0.01470 (0.09464)	12.846
38.47 (265.24)	26.71 (184.16)	2.83	0.05 (0.127)	-	0.05 (0.127)	0.00006213 (0.0013459)	0.00217 (0.01400)	1.882
35.32 (243.52)	27.22 (187.68)	2.17	0.05 (0.127)	4	0.2 (0.508)	0.0003285 (0.0053832)	0.00869 (0.05606)	7.628
33.39 (230.22)	26.15 (180.30)	1.67	0.05 (0 127)	7	0.35 (0.889)	0,0006749 (0.0094209)	0.01520 (0.09806)	13.221
31.69 (~18.49)	(25.67 (176.99)	1.67	0.05 (0.127)	10	0.5 (1.27)	0.0008213 (0.0134587)	0.02172 (0.14013)	19.272
37.97 (261.79)	26.72 (184.23)	2.33	0.059 (0.15)	-	0.059 (0.1499)	0.0001344 (0.0022624)	0.00304 (0.01961)	2620
- 34.97 (241.10)	26.44 (182,30)	2.50	0.059 (0.15)	2	0.118 (0.2997)	0.0002668 (0.0043721)	0.00608 (0.03923)	5,541
34.45 (237.53)	26.69 (184.02)	2.67	0.059 (0.15)	3	0.177 (0.4496)	0.0004002 (0.0065581)	0.00912 (0.05884)	8.068
33.66 (232.06)	26.12 (180.09)	2.00	3.059 (0.15)	*	0.236 (0.5994)	0.0005336 (0.0087441)	0.01216 (0.07845)	10.589
32 J) (227.60)	25.74 (177.47)	233	0.059 (0.15)	ŝ	0.295 (0.7493)	0.000667 (0.0109302)	0.01520 (0.09806)	13.179
32 (224.91)	25.86 (178.30)	1.67	0.059 (0.15)	9	0.354 (0.8992)	0.0008004 (0.0131162)	6.01823 (0.11761)	15.719
31.60 (217.87)	25.93 (178.78)	2.00	0.059 (0.15)	1	0.413 (1.0490)	0.0009338 (0.0153022)	0.02127 (0.13723)	18.547

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45

TABLE A-6. (Concluded)

<u> </u>	T	Т	Т	Т	Т	Т	T	7	Т	7	T	1	٦	1	7	T	1	Т	Т	Т	7	┪	7	Т	Т	Т	Т	Т	Г	-	П		T	Т	Ť	_
CROSS— SECTIONAL PERCENT PORE AREA	21.844	3.910	7.575	11.593	15.283	18.694	23.045	26.979.	4.872	9.879	14.729	19.879	24.547	30.106																						
ACCUMULATIVE PORE AREA INCHES ² (cm ²)	0.02431 (0.15684)	0.00437 (0.02819)	0.00873 (0.05632)	0.01310 (0.08452)	0.01747 (0.11271)	0.02184 (0.14090)	0.02620 (0.16903)	0.03127 (0.20174)	0.005/0 (0.036/7)	0:01140 (0:0/355)	0.01710 (0.11032)	0.02280 (0.14710)	0.02850 (0.18387)	0,03420 (0,22064)																						
ACCUMULATIVE PORE VOLUME INCHES ³ (cc)	0.001067 (0.0174850)	0.0002336 (0.0038280)	0.0004672 (0.0076560)	0.0007008 (0.114841)	0.0009344 (0.0153121)	0.001168 (0.0191401)	P;001402 (0.0229747)	0.0016.35 (0.0267928)	0.0003501 (0.005/371)	0.0007002 (0.0114742)	0.00105 (0.0172064)	0.0014 (0.0229419)	0.001751 (0.0286937)	0.60211 (0.0345767)																						
ACCUMULATIVE PORE LINEAR INCHES (cm)	0.472 (1.1989)	0.070 (0.1778)	0.14 (0.3556)	0.21 (0.5334)	1	1	1	┪	0.0805 (0.2045)	0.161 (0.4089)	0.242 (0.6147)	1	0.403 (1.0236)	0.483 (1.2268)				T RESULTS.										+								
NUMBER OF PORES	8	1	2	3	4	5	9	7	-	2	3	4	S	9				R MORE TEST																		
PORE DIAMETER INCHES (cm)	0.059 (0.15)	0.97 (0.178)	0.07 (0.178)	0.07 (0.178)	0.07 (0.176)	0.07 (0.178)	0.07 (0.178)	0.07 (0.178)	0.0805 (0.204)	0.0805 (0.204)	0.0805 (0.204)	0.0805 (0.204)	0.0805 (0.204)	0.0905 (0.204)			INCH WIDE	GE OF THREE O																		
ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	1.67	300	2.50	2.33	2.66	2.00	2.00	2.00	2.50	233	2.16	2.50	2.00	1.33			MENS WERE ON	IN IS THE AVERA																		
V.S., O.Z% OFFSET KSI (MIN/m ²)	24.62 (169.75)	26.92 (185.61)	27.30 (183.23)	28.20 : .1.471		(60.071) 79.85			(27.70 (190.95)	26.14 (180.23)	25.35 (174.78)	24.42 (168.37)	23.40 (161.34)	(2) 99 (15) 62)			TENSILE SPEC	H VALUE SHOP																		
U. T. S., KSI BM/m ²)	30.55 (210.64)	37.22 (257.22)	36.40 (244.08)	33.46 (236.70)	31.92 (220.09)	30.74 (211.95)	29.62 (204.23)	28.95 (199.61)	36.37 (250.76)	32.52 (231.12)	32.19 (221.94)	29.89 (206.09)	29 04 (200,23)	27.18 (187.26)		MOTES	(1) AL																			

TABLE A-7. FLUSH BEAD TENSILE RESULTS FOR 0.250-IN. (0.635-CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.250 IN. (0.635 CM) ALUMINUM ALLOY 2219-T87

CROSS— REA SECTIONAL PERCENT (cm ²) PORE AREA				(0.001277) 0.3328				(U.402581) U.7/41			L	0.008555) 2.2532					-		1	(0.034277) 8.950	1	(0.056//4) 14.52/3	00.00.00	\downarrow						
ACCUMULATIVE PORE AREA INCHES ² (cm ²)				0.000198	0.000264	0.00033	0.000396	0.000462	0.000058		0.0009945	-		-	0.0012395	0.002479	-	0.0029585	0.005917	0.005313	0.010626	0.0088	001162							
ACCUMULATIVE PORE VOLUME INCHES (cc)	0	0.00000603 (0.00000988) 0.000066	0.000001206 (0.00001976)	0.000001809 (0.00002964)	0.000002412 (0.00003953)	0.000003015 (0.00004941)	0.000003618(0.00005929)	0.000004221 (0.00006917)	0.000004824 (0.00007905)	0.0000042.50 (0.0000050)	0.00001305 (0.0003082)	0.00001694 (0.0002776)	0,000021175 (0.000347)	0.00002541 (0.0004164)	•	ı	•	١	ı		1	_	0.001048 (0.0171736)	U.UUTBOB 10.USUSUS)			ž.			
ACCUMULATIVE PORE LINEAR INCHES (cm)	0	0.009 (0.0229)	0.018 (0.0457)			0.045 (0.1143)			0.072 (0.1829)		0.038 (0.788)	0.078 (0.1981)		0.117 (0.2972)	0.037 (0.0940)	0.074 (0.1880)	0.111 (0.2312)	0.0585 (0.1486)	0.117 (0.2972)	0.0795 (0.2019)	0.159 (0.4039)	0.1906 (0.2553)	0.118 (0.2997)	0.143 (0.3632)			MORE TEST RESUL			
NUMBER OF PORES	•	-	2	m	*	9	9	7	60	-	2	•	ı,	9		2	3	-	64	-	2	F		-			THREE OR			
PORE DIAMETER INCHES (cm)	0	0.009 (0.0229)	,	0.009 (0.0229)		0.009 (0.0229)		0.009 (0.0229)	0.009 (0.0229)	0.0135 (0.0435)	0.0195 (0.0495)	0.0195 (0.0495)	0.0195 (0.0495)	0.0195 (0.0495)	0.037 (0.0940)	0.037 (0.0940)	0.037 (0.0940)	0.0585 (0.1486)	0.0595 (0.1436)	0.0795 (0.2019)	0.0795 (0.2019)	1	- 1	0.143 (0.3632)			AVERAGE OF			
ELONGATION IN Z INCH (5.08 cm) GAGE LENGTH, PERCENT	2	43	4.5	70	4.2	3.7	3.3	3.8	2.8	4.5	4.5	7.4	3.2	3.7	3.5	3.0	3.3	3.0	2.8	2.8	3.0	2.8	2.5	25			SHOWN IS THE			
Y.S., 0.2% OFFSET KSI (MN/m ²)	77 95 (142 71)	28.67 (197.67)	77 31 (188 30)	28 10 (193 74)	27.85 (192.02)	27.46 (189.33)	27.47 (189.40)	27.52 (189.74)	27.47 (189.40)	27.27 (186.02)	77.94 (192.64)	171 1611 27 72	28.25 (194.78)	(50.181) (1.02)	27.00 (186.16)	27.52 (189.74)	27.27 (188.02)	27.53 (189.81)	26.06 (179.68)	(97.671) 70.35)	23.72 (163.54)	25.04 (171.65)	23.60 (162.72)	19.97 (137.69)			EACH VALUE			
U. T. S., KSI (MN/m²)	A: 72 (20) EKI	41 77 (207 GE)	4: 42 (28) EE)	A 83 (28 20)	(285,38)	41 28 (284.62)	41.11 (283.46)	40.80 (281.31)	38.83 (267.73)	41.44 (286.00)	41.57 (286.62)	(0,007) 28-19	40 00 (261 86)	40 64 (250 20)	41.15 (283.72)	40.42 (278.69)	37.84 (280.90)	38.91 (268.28)	35.01 (241.39)	37.43 (258.07)	32.33 (222.81)			28.89 (185.40)			NOTE			



TABLE A-S. FLUSH BEAD TENSILE RESULTS FOR 0.50-IN. (1.27-CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY 2219-T87

		ELONGATION	1	_		ACCIMINATIVE	ACCIMINATIVE	SECTIONAL
(IN 2 INCH	PORE	NUMBER	ACCOMOLATIVE PORF LINEAR	PORE VOLUME	PORE AREA	PERCENT
U. T. S.,	OFFSET 2	(m) 20.61	DIAMETER (TE)	3200	INCHES (cm)	INCHES (cr)	INCHES ² (cm ²)	PORE
(_m/N	KSI (MN/m-)	LENGTH, DERCENT	ואכחבא נכווו)					AREA
						5	°	0
41.72 (287.65)	27.95 (192.71)	47			0.018 (0.0467)	A 000001306 (0.00001976)	0.000132 (0.000652)	0.1112
41.88 (288.75)	28.26 (194.85)	4.0				n nnonn2412 (0.00003963	0.000264 (0.601703)	0.2222
41.36 (285.17)	27.80 (191.68)	3.7	- 1		- 1	n nonnnas 18 (0.00005929)	0.000396 (0.002555)	0.3345
41.19 (284.00)	27.63 (190.50)	07	- 1			D 000004824 (0 00007906)	0.000628 (0.003406)	0.4437
39.89 (275.03)	27.33 (188.43)	0.7	_	2	1	ה מממחנים וו הביושמים ה	0.00066 (0.004258)	6055.0
42.10 (290.27)	28.43 (196.02)	4.2	_	20	- 1	5 00000236 (0 0001 1858)	1	0.665
60.57 (279.72)	(27.81(191.74)	3.5	0.009 (0.0229)	12	- 1	L. 000007.230 (0.000) (0.000)	1	200
41.04 (282.96)	28.09(193.67)	3.3	0.009 (0.0229)	16	- i	0:000009646 10:00013891	1	0 6586
41.81 (288.27)	(26.061)6972	0.7	0.0195 (0.0495)	7	-:		1	1 1163
(67, 772) (57, 79)	(21.191.12)	2.8	0.0195 (0.0495)	•	ij	- 1	1	9835
41 42 (785 58)	28.50 (196.50)	3.5	0.0195 (0.0455)	9	- 1			2000
41 nn (282 69)	27.00 (186.16)	4.2	0.0195 (0.0495)	æ	9.156 (0.3962)	- 1		2 705.
40 FO (27E A1)	27 15 (187 19)	33	00195 (0.0495)	10	0.196 (0.4953)	- 1		7.7301
100 (2.70° 10)	26 80 (185 An)	2.2	0.0195 (0.0495)	12	0.234 (0.5944)	0.00005082 (0.0008328)	0.003978 (0.025664)	33401
33:05 1005 10)	77 10 1985 95		0 0037 (0 0040)	-	0.037 (0.0940)	- 1	0.0012395 (0.007997)	1,0495
100	20 40 100.00		0.007 (0.0040)	-	0.074 (0.1880)	0.00006856 (0.0011399)	0.002479 (0.015994)	2.1044
M. 97 (262.45)	10.0011000	2.2	0.027 10.0040)		ł	0.00010434 (0.0017098)	0.0037185 (0.02399)	3.1353
40.22 (278.00)	27.04 (103.13)	200		•			0.004958 (0.031987)	4.1804
39.47 (272.14)	7/.23 100.10	0.00		-		0.0001739 (0.0028497)		5.2655
39.49 (772.28)	27.33 1188.43	9.7	(0.00 to 10.00 to 10.		1	0.00020888 (0.0034197)	0.007437 (0.047981)	6.2286
39.07 (269.38)	(01.7611/97.10)	7.5		•		l	0.0029585	2.4924
41.34 (285.03)	Z8.US (193.AU)	775	0.0003 10. 1400	- -	0.117 (0.2972)		⊢	5.0272
38.64 (266.42)	26.58 (183.26)	3.7	13.00 (0. 140g)	7	0 1765 (0.4458)	1	┞-	7.5344
38.79 (267.45)	26.69 (184.02)	353		,	C 224 (0 5944)	1	0.011834	10.0288
36.30 (250.28)	25.93 (178.78)	27		•	0.0795 (0.2019)		0.005313	4.476
38.81 (267.59)	26.58 (183.26)	3.0	0.0/30 0.2019	<u> </u>	0 159, (0 4039)	١.	0.010626 (0.068555)	8.922
37.46 (258.28)	25.47 (175.61)	33		,			0.015939	13.3604
35.01 (241.39)	25.79(175.75)	3.5	0.0/30 (0.2013)	2	0 1005 (0.2553)		0.0088	7.464
37.91 (261.38)	25.42 (182.16)	200		- 6	0.201 (0.5105)	0.0013144 (0.0215392)	0.0176	14.8396
34 95 (240.97)	24.75 (170.65)	3.0		•	0 118 (0 2997)	1	0.01182	59963
35,90 (247.52)	25.63 (176.71)	3.2	9	- 6		1	0.07364	19,9328
31.34 (216.02)	23.70 (163.41)	62	9	7			0.01752 (0.113032)	14.7723
33 25 (23 03)	24.34 (167.82)	25	3	- -	- 1	-	0.03504 (0.226084)	29.6196
27.62 (190 43)	21.69 (149.55)	23	0.143 (0.3632)	2	- 1	1	i	
. :								
POTE	EACH VALL	EACH VALUE SHOWN IS THE	AVERAGE OF TH	HREE OR MO	RE TEST RESULTS.			
	1 1 1							

TABLE A-9. FLUSH BEAD TENSILE RESULTS FOR 1.00-IN. (2.54-CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY 2219-T87

The State of the second of th

				,				
		ELONGATION						CROSS-
	Y. S. 0.2%	IN 2 INCH	PORE	NUMBER	ACCUMULATIVE	ACCUMULATIVE	ACCUMULATIVE	SECTIONAL SECTIONAL
-	OFFEET	(F. 00 cm)	DIAMETER	n n	PORE LINEAR	PORE VOLUME	PORE AREA	PERCENT
J. C. (100) (2)	Š	GAGE	INCHES (cm)	PORES	INCHES (cm)	INCHES ³ (cc)	INCHES ² (cm ²)	PORE
EL/MEN ICY		LEWGTH						AREA
		PERCENT	-					
130 2007	100000		e	c	6	0	0	0
41.72.1287.00	27.30 (192./1)	4 4	0.000 (0.0229)	ur.	0.045 (0.1143)	0.000003015 (0.00004941)	0.00033 (0.002129)	0.138
67767777	+	000	0.000 (0.0229)	10	0.09 (0.2286)	(188600000) (0.0000000000	0.00066 (0.004258)	0.2768
(SE 100) 00 78	+	200	0 000 to 0229)	2	0.135 (0.3429)	0.000009045 (0.00014822)	0.00099 (0.006387)	0.4144
41.30 (484.76)	+	34	0.000 (0.0220)	8	0.18 (04572)	0.00001206 (0.000197628)	0.00132 (0.008516)	0.5528
1250/123301	+		0.000 (0.0029)	×	0.225 (0.5715)	0.000015075 (0.000246953)	0.00165 (0.010645)	0.6968
42.03 (203.73)	+		0.000 (0.0229)	S	0.27 (0.6858)	0.00001809 (0.000296442)	0.00198 (0.012774)	0.8379
41.81 (288.27)	+	1	0.000 (0.029)	E	0.297 (0.7544)	0.000019899 (0.000326086)	0.002178 (0.014052)	0.9186
41.24 (284.34)	+		0.0405 (0.0405)	•	0.0105 (0.0405)	0.000004235 (0.00006934)	0,0003315 (0,002139)	0.1397
42.23 (291.17)	+	4.3	0 0 100 (10 0 100)	•	0.078 (0.1981)	0.00001694 (0.0002776)	0.001326 (0.00855)	0.5516
41.30 (284.76)	+	3:0	0.0130 10.04337	,	n 1365 (n 3467)	0.000029645 (0.0004858)	0.0023205 (0.014971)	0.9713
40.37 (278.34)	+	97	0.0130 (0.0433)	١	0.105 (0.4053)	0.00004235 (0.000694)	0.003315 (0.02139)	1.3963
41.47 (285.93)	28.61 (197.26)	3.3	0.0130 (0.0430)	2 5	0.5526 (0.6620)	O OCCUPENSE (O OCCUPANO)	0.0043095 (0.0278)	1.8145
39.97 (275.59)	┪	3.5	0.0195 (0.0495)	13	U.2030 (U.0439)	0.000055555 (0.00055£)	0.006304 (0.03422)	222
40.62 (280.07)	28.67 (197.67)	3.5	0.0195 (C.0495)	16	0.312 (0.7925)	0.00006/76 (0.001110 4)	0.000000 10.00001	2000
39.38 (271.52)	27.74 (191.26)	3.3	0.0195 (0.0495)	19	0.3705 (0.9411)	0.000080465 (0.0013186)	0.0062985 10.04064)	/9007
39.67 (273.52)	1	3.3	0.0195 (0.0495)	z	0.429 (1.0897)	0.00009317 (0.0015268)	0.007293 (0.04705)	3.0733
20 01 (774 48)	1	2.8	0.0195 (0.0495)	92	0.4875 (1.2383)	0.000105875 (0.001735)	0:0082875 (0.05347)	3.4909
41 78 (288 06)	†	4.0	0.037 (0.094)	-	0.037 (0.094)	0.00003478 (0.0005699)	0.0012395 (0.007997)	0.5206
AD 02 (276 00)	†	43	0.037 (0.094)	3	0.111 (0.2819)	0.00010434 (0.0017099)	0.0037185 (0.02399)	1.5500
20 84 (274 66)	Ť.	25.	0.037 (0.094)	G	0.185 (0.4699)	0.0001739 (0.0028497)	0.0061975 (0.039984)	2.592
20 60 (266 94)	†	3.3	0.037 (0.094)	,	0.259 (0.6579)	0.00024346 (0.00399)	0.0086765 (0.05598)	3,6502
-B. 00 1200. 14	+	25	0.037 (0.094)	¢	0 296 (0.7518)	0.00027824 (0.00456)	0.009916 (0.06397)	4.149
38.38 (264.62)	Т		0.027 (0.004)	9	0.333 (0.8458)	0.00031302 (0.005129)	0.0111555 (0.07197)	4.6637
10.00 (200.40)	20.00 (193.32)		0 037 (0 004)	٤	0.37 (0.94)	0.0003478 (0.005699)	0.012395 (0.07997)	5.1732
38.41 (264.83)	Т.		0.037 (0.094)	=	0.407 (1.0338)	0.00038258 (0.006269)	0.0136345 (0.08732)	5.7216
37.62 (400.70)	†	3:5	10000	3.2	0.444 (1.1278)	0.00041736 (0.006839)	0.014874 (0.09596)	6.226
44 70 (264 69)	20 75 (100.72)	25	0.0585 (0.1486)	-	0.0585 (0.1486)	0.0001344 (0.0022024)	0.0029585 (0.019087)	1.2488
A 18 (277 03)	+-	3.7	0.0585 (0.1486)	2	0.117 (0.2972)	0.0002688 (0.0044049)	0.005917 (0.038174)	2.5072
20 22 (270 48)	+-	35	0.0585 (0.1486)	6	0.1755 (0.4458)	0.0004032 (0.0066073)	0.0088755 (0.057261)	3.7449
20 05 (269 24)	+-	3.2	0.0585.(0.1486)	4	0.234 (0.5944)	0.0005376 (0.0088097)	0.011834 (0.076348)	4.9911
20.00 (20.2.86)	+-	2.6	0.0585 (0.1486)	G	0.2925 (0.7430)	0.000672 (0.011012)	0.0147925 (0.09544)	6.2787
	+	2.8	0.0585 (0.1485)	٠	0.351 (0.8915)	0.0008064 (0.0132145)	0.017751 (0.11452)	7,4741
20 OE (200 42)	+	33	0.058= (0.1496)	7	0.4095 (1.0401)	0.0009408 (0.0154169)	0.0207095 (0.13361)	8.6796
1	t	28	0.0585 (0.1486)	8	0.468 (1.1887)	0.0010752 (0.0176194)	0.023668 (0.1527)	9.9195
(at nati et m	Т		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-	0.0795 (0.2019)	0.0003011 (0.0049341)	0.005313 (0.034277)	2.2503
20 12 12 12 12 12 12 12 12 12 12 12 12 12	20 72 100 02		19105 (0 2019)	-	0.159 (0.4039)	0.0006022 (0.0098683)	0.010626 (0.068555)	4.5153
38.80 (267.52)	Т		0 0 70K IO 2019	-	0.2365 (0.6058)	0.009033 (0.0148024)	0.015939 (0.102832)	6.7282
38 52 (265.59)	+	2 4	0.0/30 10.2013/		TEND IN DATE	(982,600)	0.021252 (0.13711)	8.8883
36.73 (253.25)	(28.10 (179.95)	۲,	W/30 IWANS		U.STO IVADVIII			

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TABLE A-9. (Concluded)

CROSS— SECTIONAL PERCENT PORE AREA	11.2326	3,7021	7.395	11,0738	14./83/	5.00	9.9435	14.8992	19.7824	7.3061	14.6796	22.1679	29,834			1									
ACCUMULATIVE PORE AREA INCHES ² (cm ²)	0.026565 (0.17139) 0.031878 (0.20568)	0.0088 (0.056774)	0.0176 (0.113548)	0.0264 (0.17032)	0.0362 (0.2277)	0.044 (0.2639)	0.02364 (0.152516)	0.03546 (0.22877)	0.04728 (0.30503)	0.01752 (0.113032)	0.03504 (0.226064)	0,06256 (0,3391)	0.07008 (9.4521)												
ACCUMULATIVE PORE VOLUME INCHES ³ (cc)	0.0015055 (0.0246707)	0.0006572 (0.0107696)	0.0013144 (0.0215392)	0.019716 (0.032309)	0.026288 (0.043078)	0.03286 (0.053848)	0.002096 (0.0343473)	0.003144 (0.051521)	0.004192 (0.068695)	0.001886 (0.030906)	0.003772 (0.061812)	0.005658 (0.092718)	0.007544 (0.12362)												
ACCUMULATIVE PORE LINEAR INCHES (cm)	0.3975 (1.0097)	0.1005 (0.2353)	0.201 (0.5105)	0.3015 (0.7658)	0.402 (1.0211)	0.5026 (1.2784)	0.236 (0.5994)	0.354 (0.8992)	0.472 (1.1989)	0.143 (0.3632)	0.286 (0.7264)	0.429 (1.0897)	0.572 (1.4529)						RESULTS.						
NUMBER OF PORES	ro a	-	2	3	4	2	- (•	2	6	*					•	MORE TEST RESULTS.						
PORE DIAMETER INCHES (cm)	0.0295 (0.2019)	0,1005 (0,2553)	0.1006 (0.2553)	0.1005 (0.2553)	0.1005 (0.2553)	0.1005 (0.2553)	0.10 (0.2997)	(7967)	0 118 (0.2997)	0.143 (0.3632)	0.143 (0.3632)	0.143 (0.3632)	0.143 (0.3632)						E OF THREE OR						
ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	3.7	33				T		300				3.0	2.8						FACH VALUE SHOWN IS THE AVERAG						
Y. S., 0.2% OFFSET KSI (MIN/m ²)	25.76 (177.61)	27.26 (187.95)	27.20 (187.54)	27.25 (187.88)	25.33 (174.66).	25.37 (174.92)	27.61 (190.37)	26 (7) (472 BE)	2007/11/2005	26.36 (181.61)	24.74 (170.58)	22.46 (161.75)	22.51 (155.20)						VALUE SHOW	2000					
U. T. S., KSI (MN/m²)	36.33 (250.49)	30 11 (269 66)	36 (262.35)	36.46 (251.38)	36.01 (241.39)	33.94 (234.01)	Т		23.5. 23.6.	24 F4 (25) 07)	24 43 (237 30)	21 13 (214 64)	28.95 (199.60)						MOTE: EACH						

TABLE A-10. FLUSH BEAD TENSILE RESULTS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.50 IN. (1.27 CM) PLATE ALUMINUM ALLOY 2219-T87

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		ELONGATION		_				CROSS-
=		IN 2 INCH	PORE	NUMBER	ACCUMULATIVE	ACCUMULATIVE PORE VOLUME	ACCUMULATIVE PORE AREA	PERCENT
	Š	GAGE	INCHES (cm)	PORES	INCHES (cm)	INCHES ³ (cc)	INCHES ² (cm ²)	PORE
		LENGTH, PERCENT						AREA
(30 000) 30 07	77 92 (191 89)		٥	_	°	0	0	0
42.20 (200.30)	28 53 (196 71)	4.2	0.0125 (0.0318)	5	0.125 (0.318)	0.00001244 (0.0002039)	0.00138 (0.0089)	0.273
41.51 (286.20)	27.72 (191.12)	4.5	0.0125 (0.0318)	15.	0.1875 (0.476)	0.00001866 (0.0003058)	0.00207 (0.0134)	0.413
42.27 (291.44)	27.64 (190.57)	4.0	0.0125 (0.0318)	8	0,25 (0.635)	0,00002488 (0,0004077)	0.00276 (0.0178)	0.549
40.42 (278.69)	27.17 (187.33)	38	0.0125 (0.0318)	52	0.3125 (0.794)	0.0000311 (0.0006096)	0.00345 (0.0223)	0.691
40.11 (276.55)	27.23 (187.75)	4.0	0.0125 (0.0318)	90	0.375 (0.963)	0.00003732 (0.0006116)	0.00414 (0.0267)	0.821
40.19 (277.10)	27.93 (192.57)	3.5	0.0125 (0.0316)	ಜ	0.4125 (1.048)	0.00004105 (0.0006727)	0.00455 (0.0294)	9060
43.14 (297.44)	28.30 (195.12)	3.5	0.019 (0.0483)	-	0.019 (0.048)	0.00000407 (0.0000667)	0.00032 (0.0021)	0.063
42.18 (290.82)	27.47 (189.40)	3.7	0.019 (0.0483)	4	0.076 (0.193)	0.00001629 (0.0002669)	0.00126 (0.0081)	0.25
41.42 (285.58)	27.52 (189.74)	3.2	3.019 (0.0483)	7	0.133 (0.339)	0.0000285 (0.000467)	0.00221 (0.0143)	0.433
41.69 (287.44)	27.17 (187.33)	4.0	0.019 (0.0483)	10	0.19 (0.483)	0.00004072 (0.0006673)	0.00315 (0.0203)	0.623
41.91 (288.96)	27.51 (189.68)	3.7	0.019 (0.0483)	13	0.247 (0.627)	0.00005294 (0.0008675)	0.0041 (0.0265)	0.817
40.28 (277.72)	26.90 (185.47)	3.0	0.019 (0.0483)	16	0.304 (0.772)	0.00006515 (0.0010676)	0.06504 (0.0325)	1.007
40.74 (280.89)	26.98 (186.02)	3.5	0.019 (0.0483)	19	0.361 (0.917)	0.00007737 (0.0012679)	0.00599 (0.0386)	1.207
40.50 (279.24)	26.89 (185.40)	3.5	0.019 (0.0483)	22	0,418 (1.062)	0.00008958 (0.001468)	0.00693 (0.0447)	1.364
40.89 (281.93)	(191.40)	3.5	0.019 (0.0483)	25	0.475 (1.207)	0.0001018 (0.0016682)	0.00788 (0.0508)	1.551
41.97 (289.37)	27.34 (188.50)	3.7	0,029 (0,0737)	1	0.029 (0.074)	0.00001565 (0.0002565)	0.00073 (0.0047)	0.144
41.47 (285.93)	28.05 (193.40)	35	0.029 (0.0737)	Þ	0.116 (0.295)	0.0000626 (0.0010258)	0.0029 (0.0187)	0.571
40.46 (278.96)	27.30 (188.23)	4.0	0.029 (0.0737)	7	0.203 (0.516)	0.0001096 (0.001796)	0.00508 (0.0328)	1.07
40.30 (277.86)	27.07 (186.54)	3.5	0.029 (0.0737)	10	0.29 (0.737)	0.0001565 (0.0025646)	0.00725 (0.0468)	1.4.53
41.09 (283.31)	26.48 (182.44)	3.5	0.029 (0.0737)	13	0.377 (0.958)	0.0002035 (0.0033348)	0.00943 (0.0608)	1.856
39.34 (271.24)	26.88 (185.33)	2.8	0.029 (0.0737)	16	0,464 (1,179)	0.0002504 (0.0041033)	0.0118 (0.0748)	2334
42.37 (292.13)	28.11 (1~5.81)	3.5	0.0393 (0.0998)	•	0.0393 (0.10)	0.00003882 (0.0006361)	0.00134 (0.0086)	0.200
39.68 (273.59)	127.70 (190.99)	3.5	C.D.393 (0.0998)	3	0.1178 (0.299)	0.0001165 (0.0019091)	0.00401 (0.0259)	CONT.
40.81 (281.38)	-	3.5	0.0393 (0.0998)	2	0.1963 (0.499)	0.0001941 (0.0031807)	0.00668 (0.0431)	1.363
40.59 (279.86)	Н	3.7	0.0393 (0.0998)	7	0,2749 (0.698)	0.0002717 (0.0044524)	0.00935 (0.0603)	20.5
40.04 (276.07)	-	3.5	0.0393 (0.0998)	CD.	0.3533 (0.897)	0.0003494 (0.005/256)	(6/70.0) 20210.0	2 888
39.33 (271.17)	+	3.5	0.0393 (3.0938)	1	0.4378 (1.097)	0.000042/ (0.0009973/	0.0147 (0.0346)	0.432
41.72 (287.65)	+	4.7	0.05 (0.127)	-	0.00 (0.167)	0.000328E (0.0053832)	0.00869 (0.0561)	1.731
41.02 (282.82)	26.68 (182.57)	4.3	0.05 (0.127)	•	0.35 (0.999)	0.0094209)	0.0152 (0.0981)	2.991
25 52 5200.14	+	3.0	0.05 (0.127)	٤	05 (4 27)	0 0008213 (0.0134587)	0.02172 (0.1401)	4.282
4: 01 (200 27)	27 10 (186.85)	30	0.059 (0.15)	-	0.059 (0.15)	0.0001334 (0.002186)	0.00304 (0.0196)	0.505
A1 56 (288 55)	+-	38	0.059 (0.15)	2	0.118 (0.30)	0.0002668 (0.0043721)	0.00608 (0.0392)	1.211
40.11 (276.55)	+_	35	0.059 (0.15)	3	0.177 (0.45)	0.0004002 (0.0065581)	0.00912 (0.0588)	1.806
39.19 (270.21)	+	43	0.059 (0.15)	4	0.236 (0.599)	0.0005336 (0.0087441)	0.01216 (0.0785)	2413
39.93 (275.31)	26.10 (179.95)	3.5	0.059 (0.15)	25	0.295 (0.749)	0.000667 (0.0109302)	0.0152 (0.0981)	3.045
39.25 (270.6.1	26.70 (184.09)	3.5	0.059 (0.15)	ø	0.354 (0.899)	0.0008004 (0.0131162)	0.01823 (0.1176)	3.619
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TABLE A-10. (Continued)

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CROSS- SECTIONAL PERCENT PORE AREA	4.244	4.854	0.879	1.72	2.597	3.447	4.301	5.278	6.152	1.127	2.257	3.394	4.503	5.653	6.837	1,336	2.687	4.012	5.463	6.763	1.716	3.474	5,139	6.871	8.677	2.077	8 3	282	2.497	4.967	7.482	766	2.97	5.9	9.037	11.952	3.637	
w _	0.02127 (0.1372)	0.02431 (0.1568)	0.00437 (0.0282)	0.00873 (0.0563)	0.0131 (0.0845)	0.01747 (0.1127)	0.02184 (0.1409)	0.0262 (0.169)	0.03127 (0.2017)	0.0057 (0.0368)	0.0114 (0.0735)	0.0171 (0.1103)	0.0228 (0.1471)	0.0285 (0.1839)	0.0342 (0.2206)	0.00678 (0.0437)	0.01356 (0.0875)	0,02034 (0.1312)	0.02712 (0.175)	0.03391 (0.2188)	0.00866 (0.0559)	0.01733.(0.1118)	0.02589 (0.1677)	0.03465 (0.2235)	0.04332 (0.2795)	0.01043 (0.0673)	0.02067 (0.1346)	0.0313 (0.2019)	001368 (0.0812)	0.015.00-(0.0015)	0.03774 (0.2438)	0.05020 (0.3248)	0.01497 (0.0963)	0.02004 (0.1925)	A DAKTE 10-20081	0.05968 (0.385)	0.04726 (0.1144)	מיסוייה ומיוונים
ACCUMULATIVE PORE VOLUME INCHES ³ (cc)	0.0009338 (0.0153022)	0.001067 (0.017485)	0.0002336 (0.003828)	0.0004672 (0.007656)	0.0007008 (0.0114841)	0.0009344 (0.0153121)	0.001168 (0.0191401)	0.001402 (0.0229747)	0.001635 (0.0267928)	0.0003501 (0.0057371)	0.0007002 (0.0114742)	0.00105 (0.0172064)	0 0014 (0.0229419)	0.001751 (0.0286937)	0.00211 (0.0345767)	0.000445 (0.0072922)	0 000kg (0.0145845)	0.001335 (0.0218767)	0.00178 (0.029169)	0.002225 (0.0364612)	0.0006443 (0.0105582)	0.001289 (0.0211229)	0.001933 (0.0316762)	0.002578 (0.0422459)	0.003222 (0.0627991)	0.000868 (0.014224)	0.001736 (0.0284479)	0.002604 (0.0426719)	C.003472 (0.0066969)	0.001135 (0.0785593)	0.0022/ (0.03/15:%)	0.003405 (0.055/98)	G.00454 (0.074387.5)	0.00146 (C.0239231)	0.00292 (0.04/8502)	0.00438 (0.0/1//53)	0.00084 (0.099/009)	0.001861 (0.0304963)
ACCUMULATIVE PORE LINEAR INCHES (cm)	0.413 (1.049)	0 472 (1.199)	0 07 (0 178)	0.14 (0.356)	0.21 (0.533)	0.28 (0.711)	0.25 (0.889)	0.42 (1.067)	0.49 (1.245)	0.0805 (0.204)	0 161 (0 409)	0 242 (0 614)	0 222 10 040)	0.322 10.0101	1200 11 200 0	0.965 11.441	10000	0.264 (0.671)	0.352 (0.804)	0.42 (1.118)	0.000.000.0	0 198 (0.503)	0.267 (0.754)	0.396 (1.006)	0.495 (1.257)	0.1.3 (0.277)	0.218 (0.554)	a327 (0.831)	0.436 (1.107)	0.1206 (0.306)	0.241 (0.612)	0.3615 (0.918)	0.462 (1.224)	0.137 (0.335)	0.264 (0.671)	0.396 (1.006)	0.528 (1.341)	Q.1415 (0.359)
NUMBER OF PORES	-	α.	-	-	,	2	-		7	-	-		,	3	n	•	- (2	,	*	•	- -	• •	,	uc	-	2	3	7	-	2	3	•	-	2	3	•	-
PORE DIAMETER INCHES (cm)	0 0E0 (0 1E)	0.050 (0.15)	0 07 (0 479)	007 10 170	001/0/100	0.07 (0.178)	00, 10, 100	00710178	(9/10) (000	0 none (0 204)	0.0000 0.204)	0.0000 10.0041	0.0605 10.204)	0.0805 (0.204)	0.08050	0.0905 (0.204)	0.020 (0.224)	0.069 (0.224)	0.000 10.2247	0.088 (0.224)	0.088 (0.224)	0.000 (0.001)	COS (C.23)	0.000 (0.001)	0.000 10.2511	0 309 (0 277)	3 1/19 (0.277)	a.10s (0.277)	Q 109 (Q 277)	Q.1205 (0.306)	0.1205 (0.306)	0.1205 (0.306)	0.1205 (0.306)	a. 132 (a.336)	0.132 (0.335)	0.132 (0.336)	0.132 (0.336)	0.1415 (0.359)
ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT		28	3/	3.5	35	3.5	4.2	3/	3	25	78	30	3.6	43	40	4.0	33	940	200	3.5	200	3.0	37	93	300	700	96	3.5	3.5	2	3.5	3.5	30	3.3	33	33	3.5	35
V. S., 0.2% OFFSET KSI (MN/m ²)		24.87 (171.47)	26.75 (181.26)	26.83 (184.99)	26.92 (185.61)	27.33 (188.43)	25.71 (777.27)	77.10 (186.85)	181.181.181	24.89 (177.61)	27.33 (188.43)	22.30 (191.68)	27.72 (191.12)	24.58 (169.47)	25.86 (178.30)	25.12 (173.20)	26.71 (184.16)	26.55 (183.06)	26.88 (185 33)	26.69 (184.02)	26.33 (181.54)	(7.89 (192.30)	26.80 (184.78)	27.11 (198.92)	27.08 (186.71)	25.17.17.27.01	27.09 1 100 / 0)	26.06 (185.19)	28.72 (164.23)	27.64 (190.57)	26.66 (183.75)	28.97 (185.95)	25.77 (177.68)	77.64 (190.57)	28.19.195	(SW.181) 85.5	ZE CR (179.82)	26.88 (185.33)
U. T. S., KSI (MN/m²)		40.92 (282.14)	39.19 (270.21)	42.37 (292.13)	40.71 (280.69)	39.95 (275.45)	40.56 (279.65)	39.48 (272.21)	39.69 (2/3.65)	76 28 (Z/0.83)	41 53 (286 34)	41.49 (286.07)	40.08 (276.34)	39.27 (270.76)	39.73 (273.92)	37.97 (261 30)	41.81 (258.27)	40.77 (281.10)	40 % (276.21)	(\$1.895) 268.14)	38.77 (267.31)	41.42 (285.58)	38.29 (270.90)	38.62 (27.2.17)	38.66 (746.48)	38.3: (264.14)	62.71 (250.34)	A. C. 121 C. A.	Te 27 (270 76)	41 9- (289 17)	(27, 177, 172)	20 CK (772 ES)	38.25 (266.48)	42.26 (290.96)	30.86 274.83)	20.30 (270.97)	TR 20 (264 S2)	41.13 (283.58)

TABLE A-10. (Concluded)

			_	<u>.</u>	_	-	+	-+	_	_	4	-			-	Ť	4	_	-		٠,	-+	Ť	+	+	+	Ť	-	7	- T	+	_	7	Т	1	+	7
CROSS—SECTIONAL PERCENT PORE AREA	6.828	10.406	13.639	3.848	7.3	11.28	4.423	8.816	13.214	5.127	10.266	15.331	6.174	12.002	17.815	6.217	12.425	18.667	6.954	14.178																	
ACCUMULATIVE PORE AREA INCHES ² (cm ²)	0.03452 (0.2227)	0.05178 (0.3341)	0.06904 (0.4457)	0.01853 (0.1195)	0.03706 (0.2391)	0.05559 (0.3586)	0.0223 (0.1439)	0.0446 (0.2877)	0.0669 (0.4316)	0.02567 (0.1656)	0.05134 (0.3312)	0.07701 (0.4968)	0.03016 (0.1946)	0.06032 (0.3892)	0.09048 (0.5837)	0.03136 (0.2023)	0.06272 (0.4046)	0.09408 (0.607)	0.03536 (0.2281)	0.07072 (0.4563)																	
ACCUMULATIVE PORE VOLUME INCHES ³ (cc)	0.003722 (0.0609927)	0.005583 (0.091489)	0.007444 (0.1219853)	0.002045 (0.0335115)	0.00409 (0.0670231)	0.00€135 (0.1005346)	0.0027 (0.0442451)	0.0054 (0.0884901)	0.0081 (0.1327352)	0.003346 (0.0549311)	0.006692 (0.;096622)	0.01004 (0.1645261)	0.004193 (0.068711)	0.008386 (0.1374219)	0.01258 (C.2061493)	0.004499 (0.0737254)	0.008998 (0.147451)	0.01349 (0.221061)	0.005471 (0.089654)	0.61094 (0.179274)																	
ACCUMULATIVE PORE LINEAR INCHES (cm)	0.283 (0.719)	0.4245 (1.078)	0.566 (1.438)	0.1485 (0.377)	0.297 (0.754)	0.4455 (1.132)	0.1605 (0.408)	0.3205 (0.814)	0:4815 (1.223)	0.171 (0.434)	0.342 (0.869)	0.513 (1.303)	0.1845 (0.469)	0.369 (0.937)	0.5535 (1.406)	0.191 (0.485)	0.382 (0.970)	0.573 (1.455)	0.2025 (0.514)	0.405 (1.029)														OR MORE TEST RESULTS.			
NUMBER OF PORES	2	3	7	1	2	3	1	2	3	ę.	2	၉	_	2	3	-	2	8	-	7														R MORE TE			
PORE DIAMETER INCHES (cm)	0.1415 (0.359)	0.1415 (0.359)	0.1415 (0.359)	0.1485 (0.377)	0.1485 (0.377)	0.1485 (0.377)	0.1605 (0.408)	0.1605 (0.408)	0.1605 (0.408)	0.171 (0.434)	0.171 (0.434)	0.171 (0.434)	0 1845 (0.469)	0 1845 (0 469)	0 1945 (0 469)	0 191 (0 485)	0 101 (0 485)	0 191 (0.485)	0 2025 (0 514)	0.2025 (0.514)													INCH WIDE.	E OF THREE			
ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	4.0	2.8	28	3.8	3.8	33	3.5	3.5	3.3	3.7	87	4.2	96	9.6	3.5	3.6	0.0	3.2	3.0	38													MENS WERE ON				
Y.S., 0.2% OFFSET KSI (MN/m ²)	26.07 (179.75)	(7) (191.47)	25.52 (175.96)	27.07 (186.64)	26.21 (180.71)	25.47 (175.61)	26.93 (185.68)	25.28 (174.30)	24 09 (166 10)	26.73 (184.30)	25 65 (176.85)	24 61 (169 68)	76 76 1977 641	(75 26 1176 37)	24 02 (165 61)	2C CE (1902 7E)	24 75 1467 201	107./01/62.47	35 67 1976 001	25.07 (170.99)													TENSILE SPEC	. 1 🐣			
U. T. S., KSI (MN/m²)	38 31 (268 28)	30 07 (269 38)	36 77 (253.52)	40 (55 (280,27)	39 49 (272 28)	38 OR (262 55)	40 71 (280 69)	27 97 (261 80)	36 77 1253 52)	40 113 (276.00)	27 01 (261 38)	26 46 (240 22)	20.10 (243.35)	36.24 (20.00)	37.40 (200.14)	30.057 00.00	39.11 (203.00)	100 DCC CC CC	35.75.1260.361	36.76 (260.33)	30.4014.30.31											NOTES			1		

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TABLE A-11. FLUSH BEAD TENSILE RESULTS FOR 0.50-IN. (1.27-CM) WIDE SPECIMENS AT -320°F (-196°C) AND CORRESPONDING POROSITY MEASURENTS OF TIG WELDMENTS (4043 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY 2014-T651

A SERVICE CONTRACTOR OF SERVICES

S., GFEET (5.08 cm) DIAMETER OF PORE LINEAR Image KSI (MN/m²) LEAGE INCHES (cm) PORES INCHES (cm) 1901 47.58 (320.81) 2.4 0.009 (0.0229) 2 0.004 (0.0231) 6.77 47.38 (326.83) 2.5 0.009 (0.0229) 6 0.064 (0.0371) 9.13 47.75 (322.82) 2.5 0.009 (0.0229) 6 0.064 (0.0372) 4.66 48.68 (326.84) 2.3 0.009 (0.0229) 1 0.024 (0.0341) 4.66 48.68 (326.84) 2.5 0.009 (0.0229) 1 0.016 (0.0431) 4.66 48.68 (326.84) 2.0 0.009 (0.0229) 1 0.016 (0.0431) 4.66 48.62 (326.12) 2.0 0.009 (0.0229) 1 0.016 (0.0231) 5.01 47.64 (327.22) 2.0 0.009 (0.0229) 1 0.016 (0.0231) 5.01 48.65 (326.64) 1.7 0.016 (0.0229) 1 0.016 (0.0231) 5.40 46.61 (320.81) 1.7 0.016 (0.0229)	ELONGATION PORE NUMBER ACCU	ACCUMULATIVE ACCUMULATIVE	ACCUMULATIVE	SECTIONAL
47.38 (320.81) 2.4 0.009 (0.0229) 4 0.036 (0.0914) 4 0.38 (320.81) 2.5 0.009 (0.0229) 4 0.036 (0.0914) 4 0.738 (320.82) 2.5 0.009 (0.0229) 8 0.0074 (0.1372) 4 0.036 (0.0914) 4	DIAMETER OF INCHES (cm) PORES		PORE AREA INCHES ² (cm ²)	PERCENT PORE AREA
47.38 (320.81) 2.4 0.009 (0.0229) 4 0.036 (0.0914) 47.38 (320.81) 2.5 0.009 (0.0229) 4 0.036 (0.0914) 48.19 (322.86) 2.5 0.009 (0.0229) 8 0.0054 (0.1372) 48.68 (325.84) 2.5 0.009 (0.0229) 12 0.0054 (0.1372) 48.68 (325.84) 2.0 0.009 (0.0229) 12 0.009 (0.0229) 14 0.036 (0.0914) 47.59 (320.12) 2.5 0.009 (0.0229) 14 0.036 (0.0239) 47.56 (325.85) 1.7 0.009 (0.0229) 14 0.036 (0.0239) 47.56 (325.85) 1.7 0.009 (0.0229) 15 0.009 (0.2286) 47.56 (320.85) 1.7 0.009 (0.0229) 16 0.049 (0.2286) 47.56 (320.85) 1.7 0.00155 (0.0419) 2 0.033 (0.0839) 47.56 (320.85) 1.7 0.00155 (0.0419) 4 0.039 (0.039) (0.091) 12 0.039 (0.091) 47.48 (320.85) 1.7 0.00155 (0.0419) 12 0.039 (0.091) 47.48 (320.85) 1.7 0.00155 (0.0419) 12 0.039 (0.091) 47.48 (320.85) 1.3 0.00155 (0.0419) 12 0.039 (0.091) 47.48 (320.85) 1.3 0.00155 (0.0419) 12 0.039 (0.091) 46.54 (320.85) 1.3 0.00155 (0.0419) 12 0.039 (0.091) 46.54 (320.85) 1.3 0.0039 (0.0991) 2 0.039 (0.0991) 46.54 (320.85) 1.3 0.0039 (0.0991) 2 0.039 (0.0991) 46.54 (320.85) 1.3 0.0039 (0.0991) 4 0.039		6	0	0
47.38 (326.86) 2.5 0.009 (0.0229) 4 0.036 (0.0914) 48.69 (325.64) 2.5 0.009 (0.0229) 6 0.006 (0.1372) 48.69 (325.71) 2.0 0.009 (0.0229) 10 0.009 (0.2286) 48.69 (325.71) 2.0 0.009 (0.0229) 11 0.009 (0.2286) 48.69 (325.81) 2.5 0.009 (0.0229) 11 0.009 (0.2286) 48.62 (326.82) 2.0 0.009 (0.0229) 11 0.009 (0.2286) 48.62 (326.82) 1.7 0.009 (0.0229) 16 0.033 (0.038) 47.10 (324.75) 1.3 0.0165 (0.049) 2 0.033 (0.038) 47.49 (327.23) 1.5 0.0165 (0.049) 12 0.039 (0.2363) 47.49 (327.23) 1.5 0.0165 (0.049) 12 0.039 (0.031) 47.49 (327.23) 1.8 0.0165 (0.099) 1 0.0169 (0.031) 47.49 (327.23) 1.8 0.039 (0.099) 1 0.039 (0.099) 46.71 (322.66) 1.8 0.039 (0.099) 1 0.0169 (0.099) 46.71 (322.66) 1.8 0.009 (0.039) 12 0.039 (0.099) 46.71 (322.66) 1.8 0.0099 (0.099) 1 0.039 (0.099) 46.71 (322.66) 1.8 0.0099 (0.099) 1 0.0099 (0.099) 46.74 (323.39) 1.3 0.039 (0.099) 1 0.039 (0.099) 46.74 (322.88) 1.8 0.039 (0.099) 1 0.039 (0.099) 46.74 (322.89) 1.8 0.079 (0.099) 1 0.039 (0.099) 46.74 (322.89) 1.8 0.079 (0.099) 1 0.039 (0.099) 46.74 (322.89) 1.8 0.079 (0.199) 1 0.039 (0.099) 46.74 (322.89) 1.8 0.079 (0.190) 1 0.019 (0.299) 47.49 (323.39) 1.8 0.079 (0.190) 1 0.019 (0.299) 48.44 (323.99) 1.9 0.079 (0.193) 3 0.039 (0.199) 49.49 (323.39) 1.9 0.079 (0.193) 3 0.039 (0.199) 49.70 (328.99) 1.5 0.079 (0.193) 3 0.039 (0.199) 49.70 (328.99) 1.5 0.009 (0.15) 3 0.039 (0.190) 40.70 (328.99) 1.5 0.009 (0.15) 3 0.039 (0.190) 40.70 (328.39) 1.5 0.009 (0.15) 3 0.039 (0.190) 40.70 (328.39) 1.5 0.009 (0.15) 3 0.039 (0.190) 40.70 (328.39) 1.5 0.009 (0.15) 3 0.039 (0.190) 40.70 (328.39) 1.5 0.009 (0.15) 3 0.039 (0.15) 3 0.039 (0.15) 4.030 (0.1	0 000 0 00000	7 1	0.000132 (0.000852)	0.1051
48.19 (322.26) 2.5 0.009 (0.0229) 6 0.054 (0.1372) 48.69 (323.24) 2.5 0.009 (0.0229) 8 0.007 (0.1829) 48.69 (325.54) 2.5 0.009 (0.0229) 10 0.009 (0.2286) 48.69 (325.54) 2.0 0.009 (0.0229) 12 0.009 (0.2286) 47.59 (325.54) 1.2 0.009 (0.0229) 14 0.026 (0.1286) 47.59 (325.54) 1.3 0.009 (0.0229) 15 0.009 (0.228) 47.52 (324.55) 1.3 0.0165 (0.0419) 2 0.003 (0.032) 47.55 (322.54) 1.7 0.0165 (0.0419) 8 0.013 (0.038) (0.038) 47.51 (324.25) 1.7 0.0165 (0.0419) 12 0.033 (0.038) (0.038) 47.51 (327.29) 1.5 0.0165 (0.0419) 12 0.039 (0.2515) 47.45 (327.23) 1.8 0.0165 (0.0419) 12 0.0165 (0.0419) 12 0.0165 (0.0419) 14 0.0165 (0.0419) 15 0.0180 (0.0921) 4.45 (327.23) 1.8 0.0165 (0.0419) 12 0.0165 (0.0419) 12 0.0180 (0.0921) 4.45 (327.23) 1.8 0.039 (0.0991) 1 0.0165 (0.0419) 12 0.0180 (0.0921) 4.47 41 (327.20) 1.3 0.0039 (0.0991) 1 0.0165 (0.0419) 12 0.0180 (0.0921) 4.47 41 (327.20) 1.3 0.0039 (0.0991) 1 0.009 (0.091) 1 0.009 (0.091) 4.47 41 (327.20) 1.3 0.0039 (0.0991) 1 0.009 (0.091) 1 0.009 (0.091) 1 0.009 (0.091) 1 0.009 (0.091) 1 0.009 (0.091) 1 0.009 (0.091) 1 0.009 (0.091) 1 0.009 (0.1901)	0.003 (0.0223)	10,000	L	0.2089
47.75 (329.23) 2.5 0.009 (0.0229) 8 0.022 (0.1829) 4.6 (325.64) 2.3 0.009 (0.0229) 10 0.009 (0.2286) 48.69 (335.71) 2.0 0.009 (0.0229) 14 0.022 (0.1286) 47.59 (328.12) 2.0 0.009 (0.0229) 14 0.022 (0.1286) 47.59 (328.12) 2.0 0.009 (0.0229) 14 0.022 (0.1286) 47.59 (328.12) 2.0 0.009 (0.0229) 14 0.144 (0.3281) 44.02 (328.24) 1.7 0.009 (0.0229) 2 0.033 (0.0839) 44.02 (328.24) 1.7 0.00165 (0.0419) 4 0.066 (0.1476) 47.85 (329.22) 1.7 0.0165 (0.0419) 4 0.066 (0.1876) 47.85 (329.22) 1.7 0.0165 (0.0419) 10 0.132 (0.336.3) 47.85 (327.23) 1.8 0.0165 (0.0419) 12 0.039 (0.0991) 3 0.039 (0.0991) 4.7 0.132 (0.336.3) 47.41 (322.06) 1.8 0.0099 (0.0991) 3 0.015 (0.0991) 4.7 0.132 (0.336.3) 47.41 (322.06) 1.8 0.0099 (0.15) 4.7 0.0099 (0.15) 4.7 0.132 (0.396.2) 4.7 0.0099 (0.15	0.003 (0.0223)	10.00	0.000396 (0.002555)	0.3281
48 68 (325,64) 2.3 0.009 (0.0229) 10 0.09 (0.2286) 4.6 (325,612) 2.0 0.009 (0.0229) 12 0.009 (0.0229) 12 0.009 (0.0229) 4.7 6. (325,85) 2.0 0.009 (0.0229) 14 0.144 (0.3688) 4.7 6. (325,85) 2.0 0.009 (0.0229) 14 0.144 (0.3688) 4.7 6. (324,54) 1.7 0.009 (0.0229) 16 0.0144 (0.3688) 4.7 6. (324,54) 1.7 0.009 (0.0229) 4.7 6. (324,54) 1.7 0.009 (0.0229) 4.7 6. (325,32) 4.7 6. (327,23)	0.009 (0.0229) 6	(0.13/2)	L	0.415.4
48 69 (325,71) 2.0 0.009 (0.0229) 10 0.009 (0.2243) 47 59 (328,12) 2.5 0.009 (0.0229) 14 0.0108 (0.2243) 48 52 (324,54) 1.7 0.009 (0.0229) 14 0.028 (0.028) 44 0.028 (0.028) 44 0.028 (0.028) 15 0.009 (0.0229) 14 0.028 (0.028) 44 0.028 (0.028) 15 0.009 (0.0229) 15 0.009 (0.0229) 16 0.044 (0.3668) 17 0.0108 (0.0419) 2 0.023 (0.0838) 47 48 52 (327,23) 1.7 0.0105 (0.0419) 8 0.0132 (0.0838) 47 48 52 (327,23) 1.5 0.0105 (0.0419) 10 0.0165 (0.0419) 10 0.	0.009 (0.0229) 8	(0.1829)	L	20.53.75
47.59 (328 12) 25 0.009 (0.0229) 12 0.108 (0.232) 47.26 (325.85) 20 0.009 (0.0229) 14 0.126 (0.328) 47.26 (324.75) 1.7 0.009 (0.0229) 16 0.134 (0.328) 47.10 (324.75) 1.7 0.0165 (0.0419) 2 0.023 (0.1328) 46.57 (324.75) 1.7 0.0165 (0.0419) 4 0.026 (0.1676) 47.86 (327.23) 1.7 0.0165 (0.0419) 1.2 0.026 (0.1676) 47.46 (327.23) 1.8 0.0165 (0.0419) 1.2 0.036 (0.0911) 47.46 (327.23) 1.8 0.039 (0.0991) 1.2 0.039 (0.0991) 47.46 (327.23) 1.8 0.039 (0.0991) 2 0.078 (0.1991) 47.21 (322.06) 1.2 0.039 (0.0991) 2 0.078 (0.0991) 46.71 (322.06) 1.2 0.039 (0.0991) 3 0.178 (0.1991) 46.72 (318.88) 1.2 0.039 (0.0991) 5 0.019 (0.1991) 46.74 (1326.88) 1.8 0.059 (0.15) 1.1 0.059 (0.15) 4	0.009 (0.0229) 10	(0.2286)	_	0.55/2
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42.54 (293.30) 1.5 0.1455 (0.3696) 1 0.1455 (0.3696) 1 0.1455 (0.3696) 2 0.291 (0.7391) 1.5 0.1455 (0.3696) 2 0.291 (0.7391) 1.5 0.1455 (0.3696) 2 0.291 (0.7391) 1.5 0.1455 (0.3696) 2 0.291 (0.7391) 1.5 0.1455 (0.3696) 1.5 0.1	0.12 (0.3048) 2	(0.6096) 0.002156	0.02436	21.1261
2 0.291 (0.7391) 1.5 0.1455 (0.3696) 2 0.291 (0.7391)	0.1455 (0.3696) 1	5 (0.3696) 0.001946	2000	27 8418
AND THE AVER	0.1455 (0.3696) 2	- 1		
EACH VALUE CHOMM IS THE AVERA				
AAA VAILLE CHOMM IS THE AVERA	-	in te		
٠.	- P			

TABLE A-12. FIUSH BEAD TENSILE RESULTS FOR 0.50-IN. (1.27-CM) WIDE SPECIMENS AT -320°F (-196°C) AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY 2219-T87

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	× ×	ELONGATION	n a C a	NIMBER	ACCUMULATIVE	ACCUMULATIVE	ACCUMULATIVE	SECTIONAL
2 - 3		(5.08 cm)			PORE LINEAR	PORE VOLUME	PORE AREA	PERCENT
Ž	¥	GAGE LENGTH, PERCENT	INCHES (cm)	PORES	INCHES (cm)	INCHES ³ (cc)	INCHES ² (cm ²)	PORE AREA
100 000 00	25 00 (241 52)	٩	6	٢	0	0	0	o
50 25 615 30	+-	2,5	0.009 (0.0229)	2	0.018 (0.0457)	0.00001206(0.00001976)	0.000132 (0.000852)	0.1126
E7 E4 (305 72)	+	40	0.009 (0.0229)	4	0.036 (0.0914)	0.000002412 (0.00003953)	0.000264 (0.001703)	0.2215
56.07 (379 35)	+-	3.8	0.009 (0.0229)	9	0.054 (0.1372)	0.000003618(0.00006929)	0.000396 (0.002555)	0.3325
53.04 (37.9.33) Fo 91 (405 48)	-	20	0.009 (0.0229)	8	0.072 (0.1829)	0.000004824(0.00007905)	0.000528 (0.003406)	0.4482
59 46 (409 95)	+	4.5	0.009 (0.0229)	10	0.090 (0.2286)	0,00000603 (0,00009881)	0.00066 (0.004258)	0.5532
55 63 (383 %)	+	3.7	0.009 (0.0229)	12	0.108 (0.2743)	D.007007236 (0.00011858)	0.000792 (0.00511)	0.6661
58 83 (405 62)	+-	4.8	0.009 (0.0229)	14	7.126 (0.3200)	D.000008442 (0.00013834)	0.000924 (0.00596)	0.7857
67 61 (397 21)	+	4.7	0.009 (0.0229)	16	0.144 (0.3658)	D.000009648 (0.0001581)	0.001056 (0.006813)	0.8949
60 40 (416 45)	-	5.0	0.195 (0.0495)	2	0.039 (0.0991)	D.00000847 (0.0001388)	0.000663 (0.004277)	0.5567
58 70 (404 72)	+	4.7	0.0195 (0.0495)	4	0.078 (0.1981)	0.00001694 (0.0002776)	0.001326 (0.008555)	1.1218
58 69 (404 66)	+-	4.5	0.0195 (0.0495)	9	0.117 (0.2972)	0.00002541 (0.0004164)	0.001989 (0.012832)	1.6827
£7 64 (397 A2)	+	4.2	0.0195 (0.0495)	8	0.156 (0.3962)	0.00003388 (0.000552)	0.002652 (0.01711)	2.2437
SE A2 (389 00)	+-	3.8	0.0195 (0.0495)	10	0.195 (0.4953)	0.00004235 (0.000694)	0.003315 (0.021387)	2.7881
57 40 1305 751	÷	0.7	0.0195 (0.0495)	12	0.234 (0.5944)	0,00005082 (0,0008328)	0.003978 (0.025664)	
57 26 (394 80)	∔	43		-	0.037 (0.094)	0.00003478 (0.0005699)	0.0012395 (0.007997)	
56 78 (39) 49)	+	4.0	0.037 (0.094)	2	0.074 (0.188)	0.00006956 (0.0011399)	0.002479 (0.015994)	2.0745
53 11 (366 18)	+-	3.5	0.037 (0.094)	က	0.111 (0.2819)	0.00010434 (0.0017098)	0.0037185 (0.02399)	3.1301
55 42 (382.11)	.	0.4	0.037 (0.094)	4	0.148 (0.3759)	0.00013912 (0.0022797)	0.004958 (0.031987)	
54 12 (373 15)	٠.	3.6	0.037 (0.094)	2	0.185 (0.4699)	0.0001739 (0.0028497)	0.0061975 (0.039984)	
55.47 (382.45)	+	co ci	0.037 (0.094)	9	0.222 (0.5639)	0.00020868 (0.0034197)	0.007437 (0.047981)	
56 21 (388 25)	35.94 (247.80)	3.0	0.0585 (0.1486)	•	0.0585 (0.1486)	0.0001344 (0.0022024)	0.0029585 (0.019087)	
55 AA (382 25)	-	3.0	0.0585 (0.1486)	2	0.117 (0.2972)	0.0002688 (0.0044040)	0.005917 (0.038174)	
53.75 (370.60)	+	3.2		3	0.1755 (0.4458)	0.0004032 (0.0066073)	0.0088755 (0.057261)	
49.46 341.02	+-	3.0	0.0585 (0.1486)	4	0.234 (0.5944)	0.0005376 (0.0088097)	0.011834 (0.076348)	10.1145
5467 37694)	-	3.5	0.0795 (0.2019)	-	0.0795 (0.2019)	0.0003011 (0.0049341)	0.005313 (0.034277)	4.4987
52 64 (362 94)	33.83 (233.25)	3.4		2	0.159 (0.4039)	0.0006022 (0.0098683)	0.010626 (0.068555)	9.0349
49 99 (344.67)	32 90 (226.84)	27	0.0795 (0.2019)	3	0.2385 (0.6058)	0.0009033 (0.0148924)	0.015939 (0.102832)	13.5510
51.66 (356.19)	33.38 (230.15)	30	0,1005 (0,2553)	1	0.1005 (0.2553)	0.0006572 (0.0107696)	0.0088 (0.0567/4)	1.430/
48 58 (334.95)	32.97 (227.32	30	0.1005 (0.2553)	2	0.201 (0.5105)	0.0013144 (0.0215392)	0.0176 (0.113548)	14.7260
50 18 (345 39)	32 96 (227 25)	3.0	0.118 (0.2997)	1	0.118 (0.2997)	0.001048 (0.0171736)	0.01182 (0.076258)	9.3051
45.19 (311.58)	23.90 (206 15)	2.6	0.118 (0.2997)	2	0.236 (0.5994)	0.002096 (0.0343473)	0.02364 (0.152516)	19.8823
47 84 (329 85)	32.05 (220.98)	25	0.143 (0.3632)	1	0.143 (0.3632)	0.001886 (0.030906)	0.01752 (0.113032)	14.003/
8 83 (267 73)	27 39 (188.85)	2.4		2	0.286 (0.7264)	0.003772 (0.061812)	0.03504 (0.226064)	63.7601
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